Sheet Metal Industries

The only Journal in the World wholly devoted to the Manufacture, Manipulation, Fabrication, Welding, Assembly and Finishing of Ferrous and Non-Ferrous Sheet and Strip

VOL. 38 : No. 411 JULY 1961 PRICE 2/6

'Speltafast' is also available in coils, 2240 lbs. min.

Editorial Contents: 477, 479

Classified Advertisements: 113 to 116

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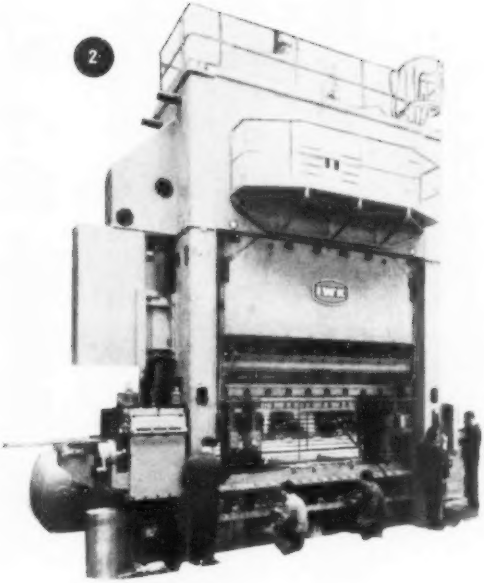

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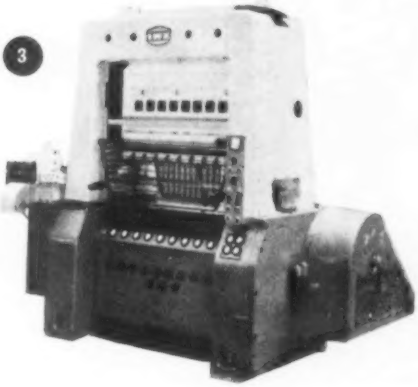

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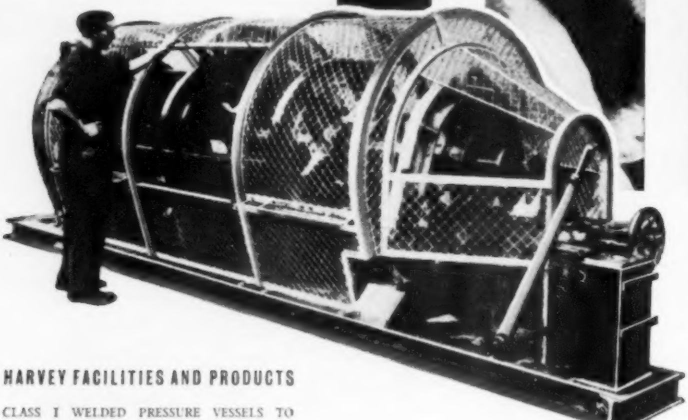

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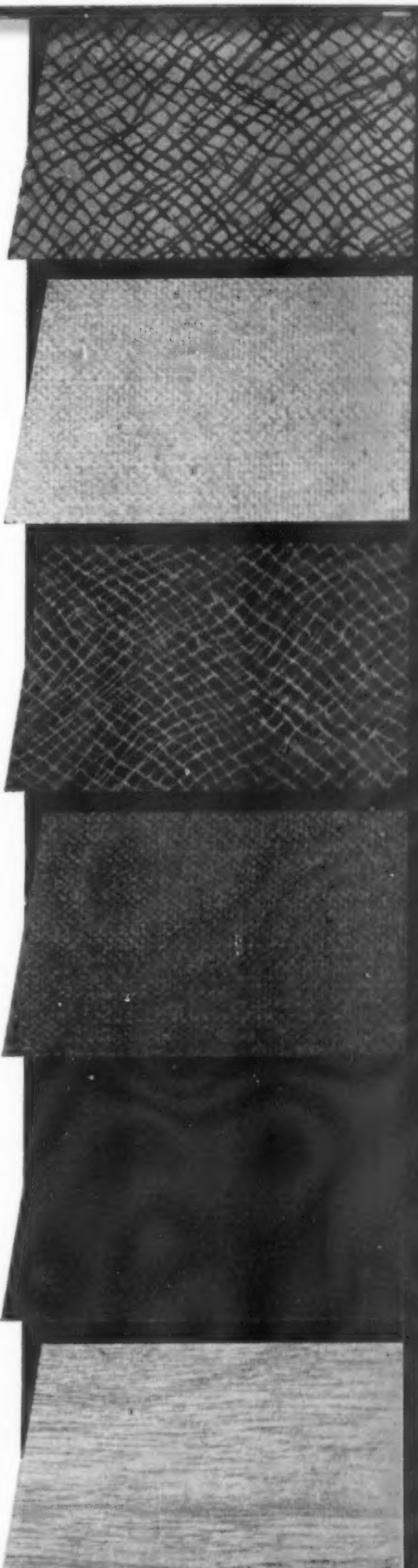

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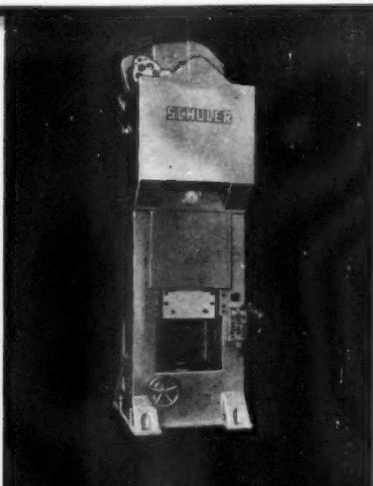

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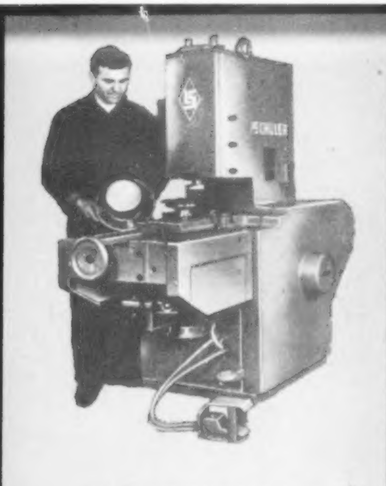

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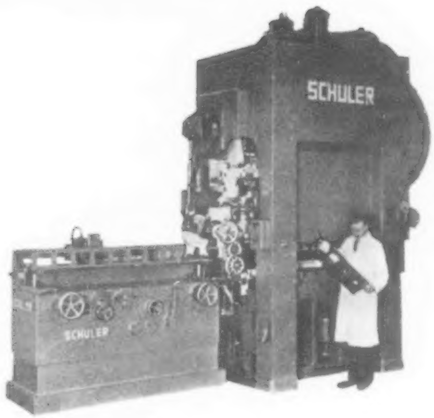

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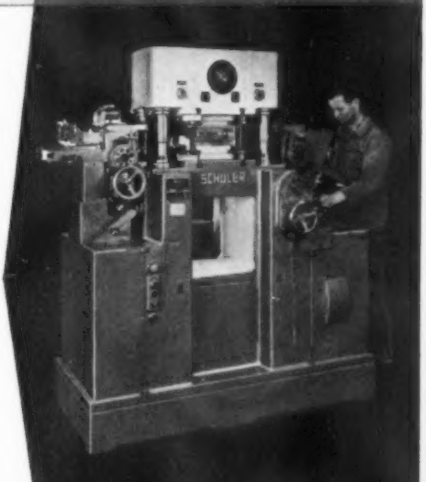

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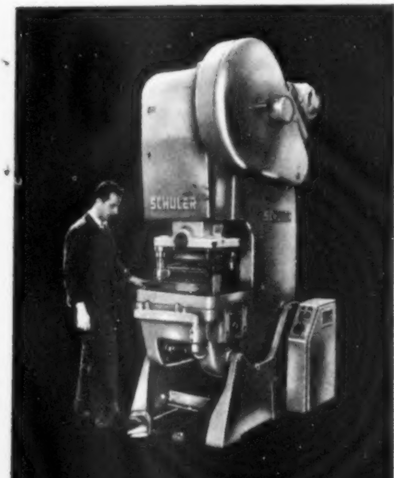

C-Frame Power Presses

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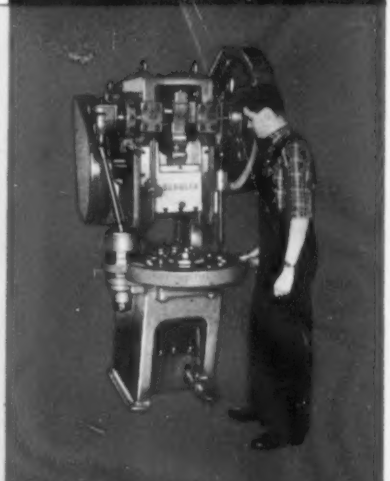

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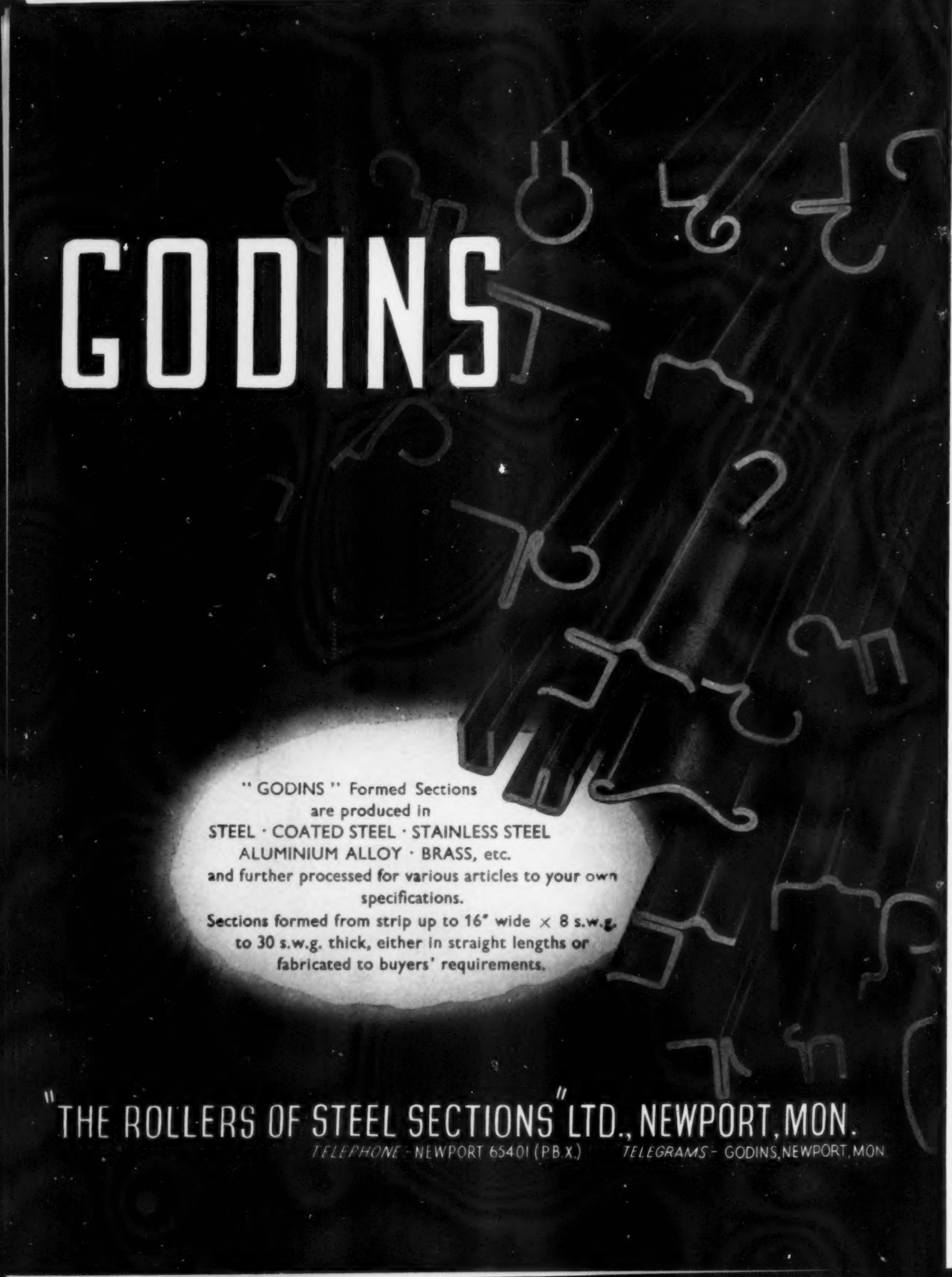
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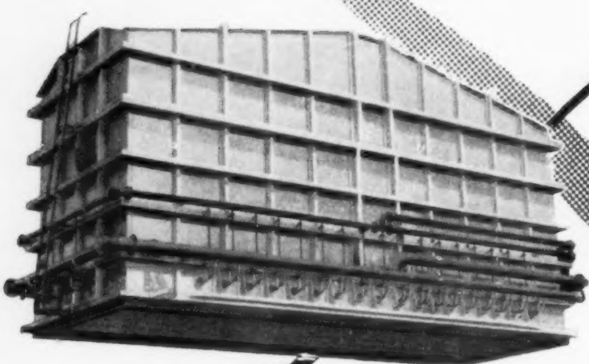

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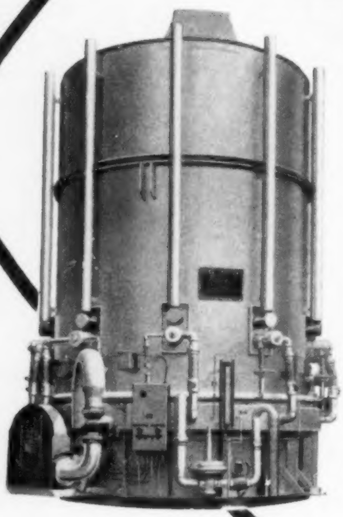

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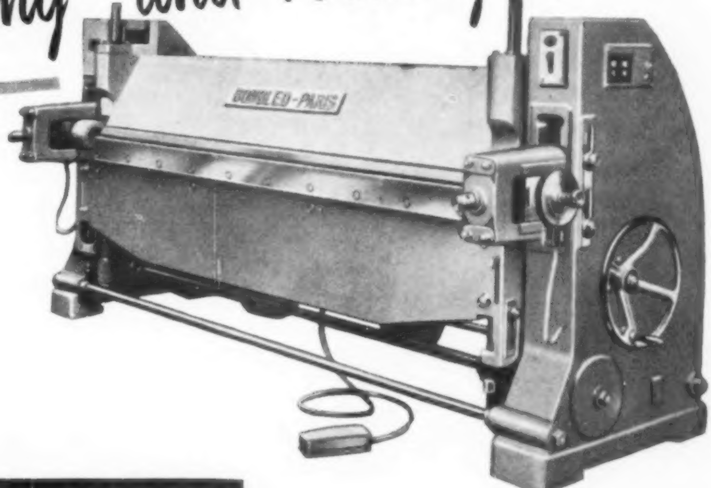

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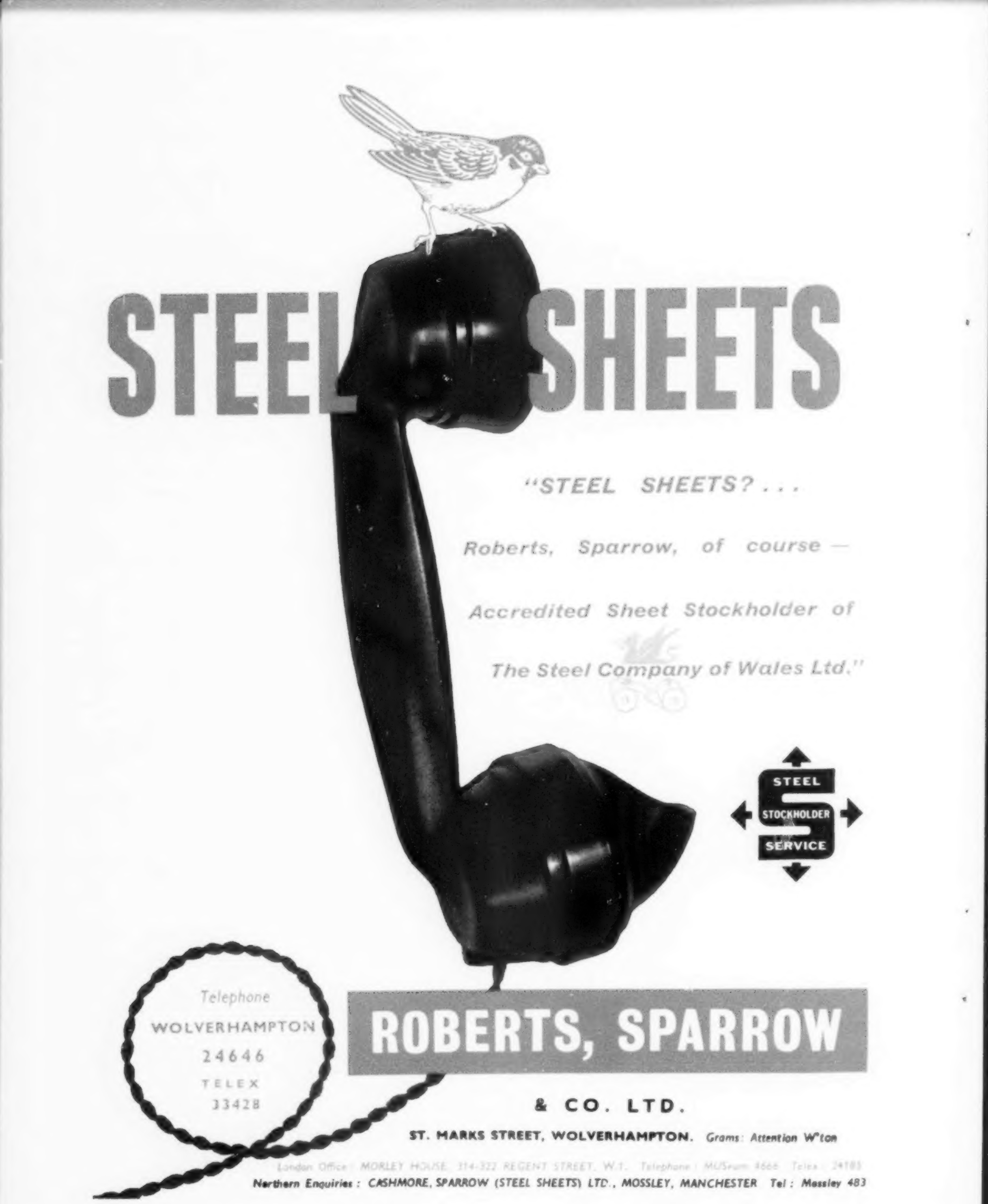
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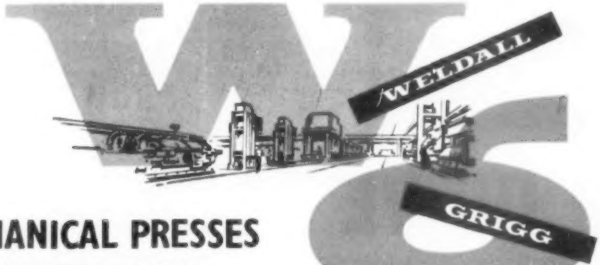

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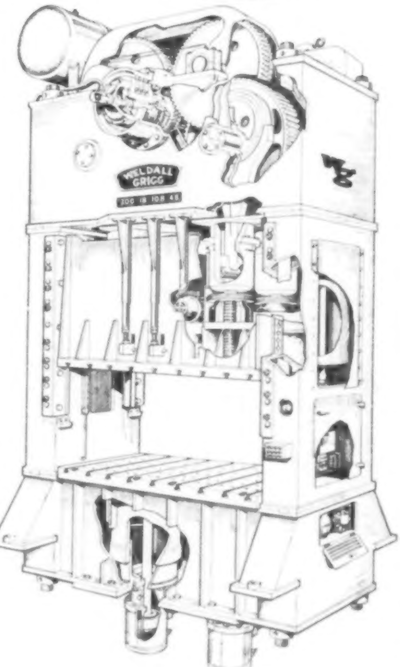

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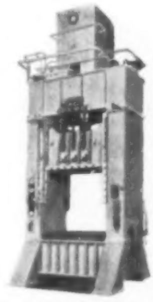

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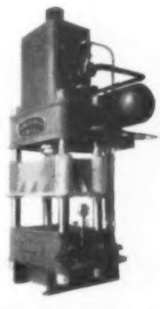

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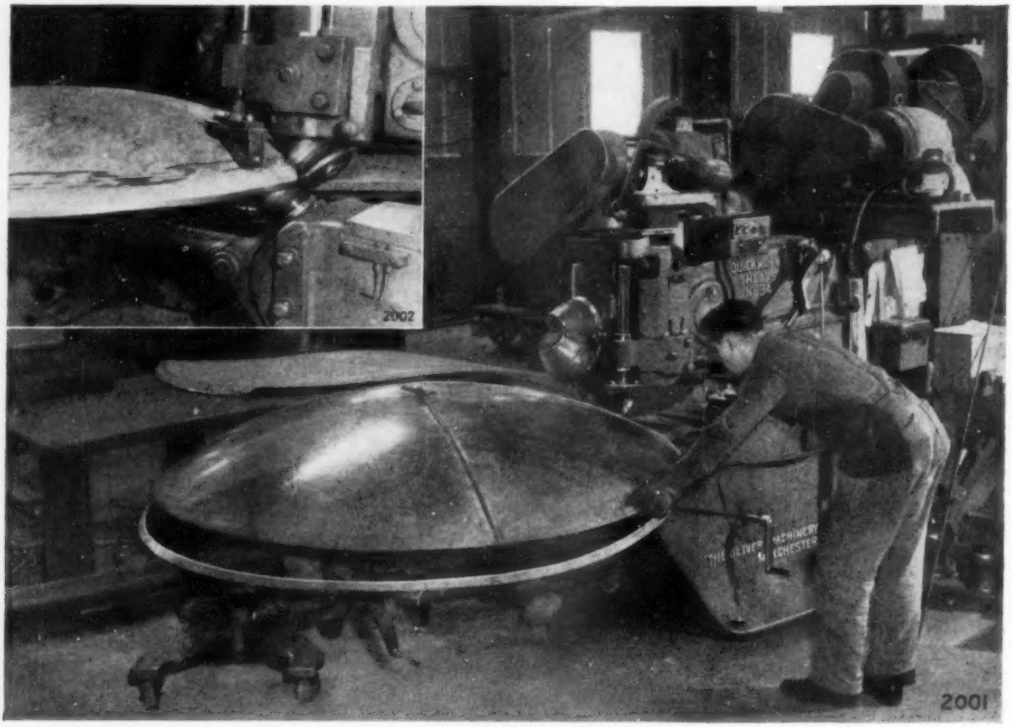

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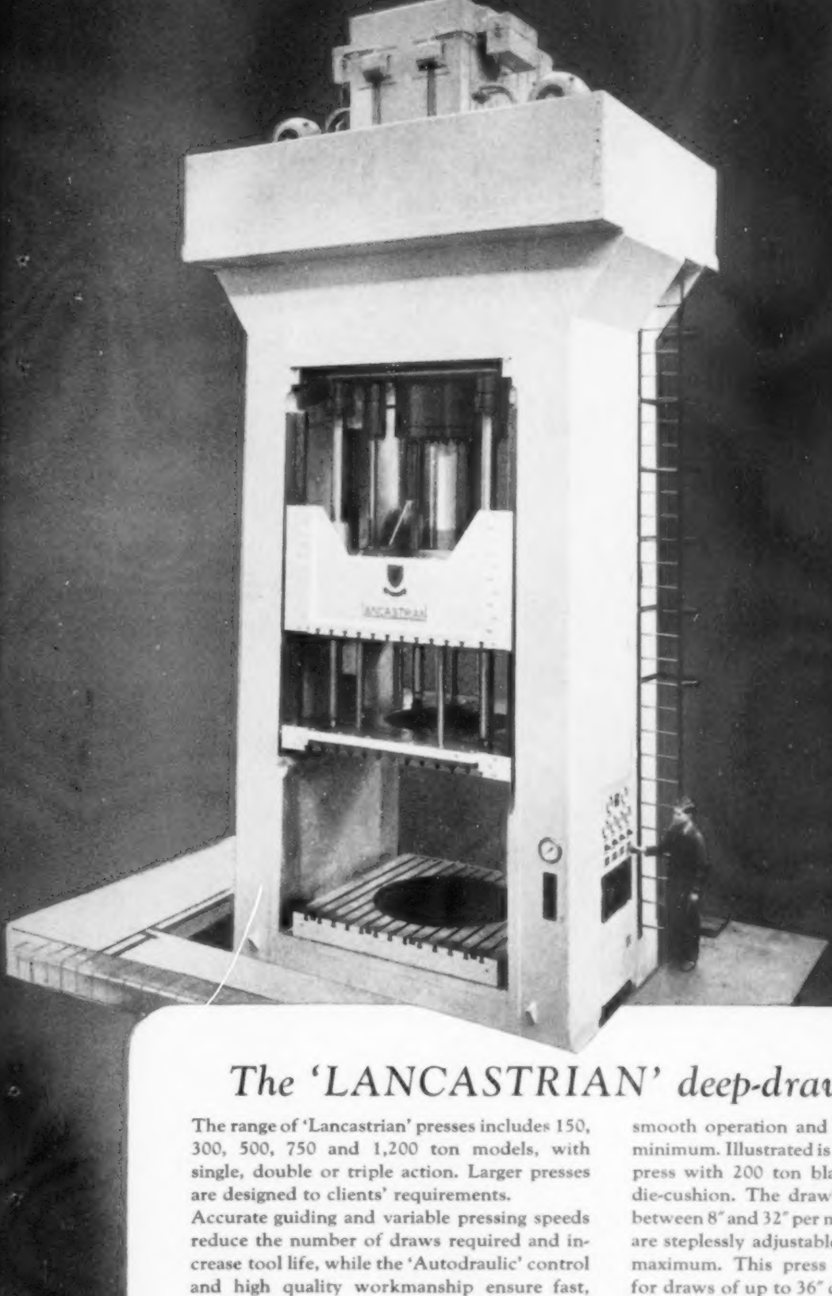

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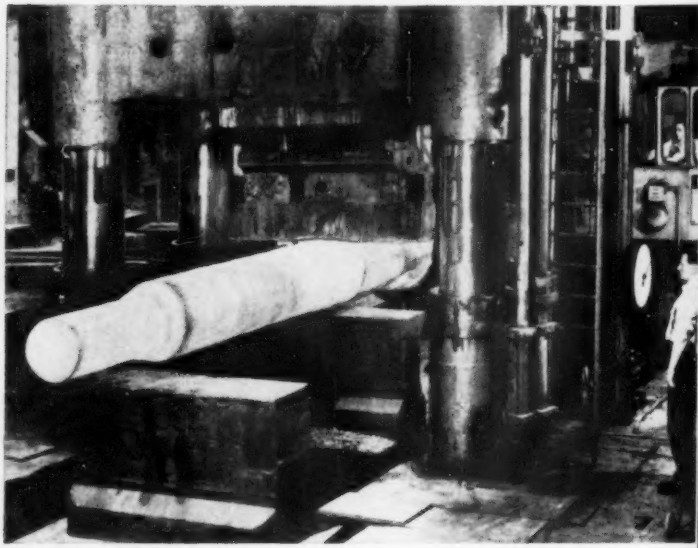

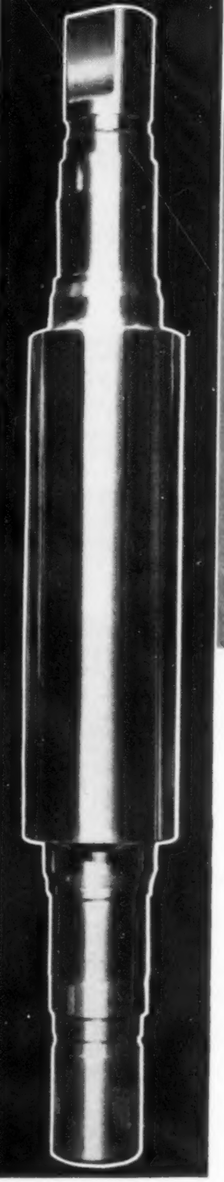

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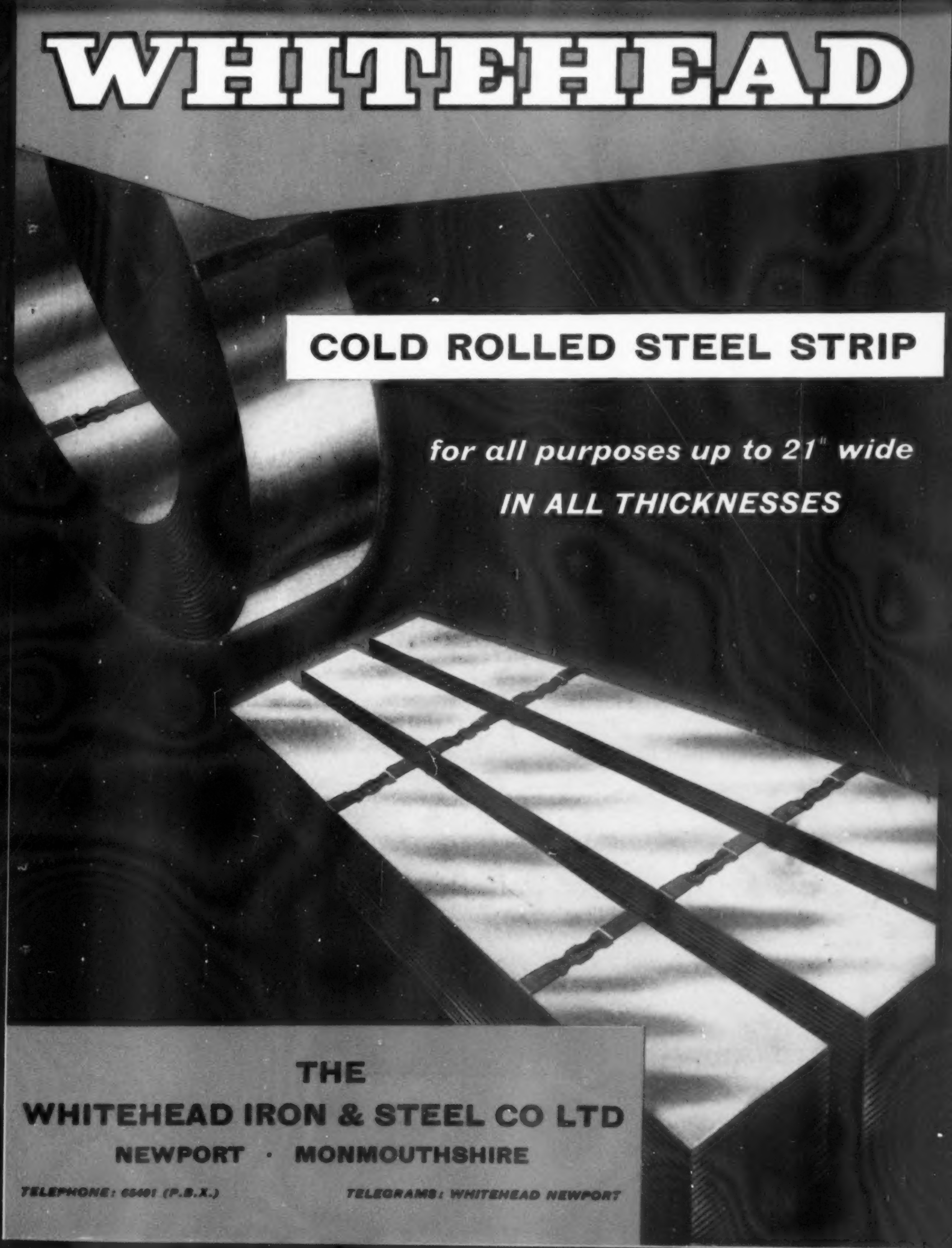

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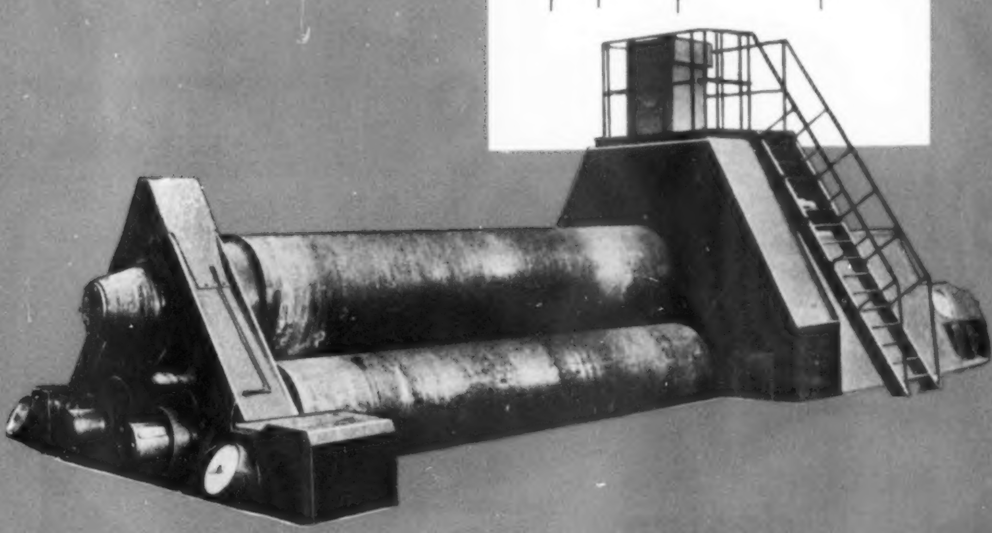

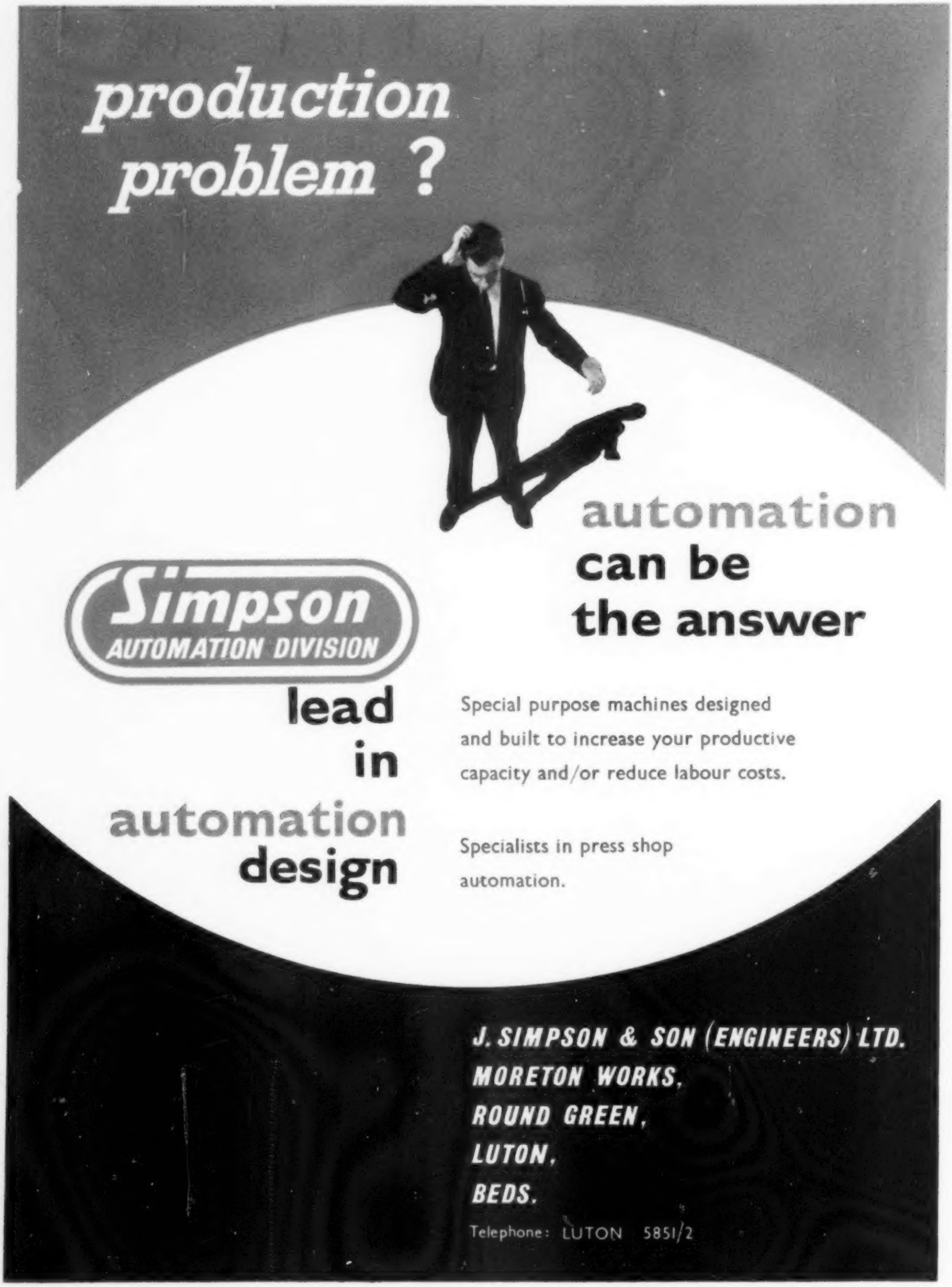
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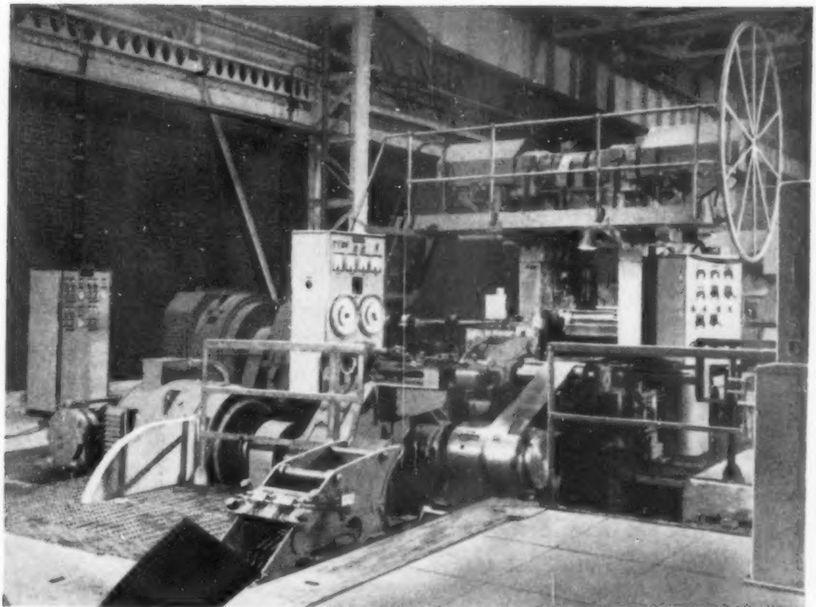

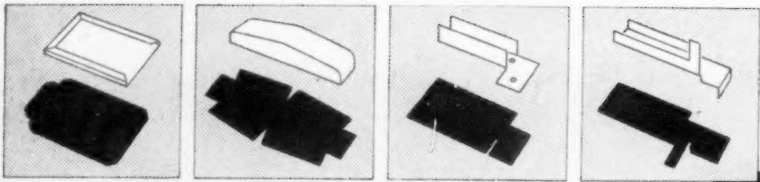

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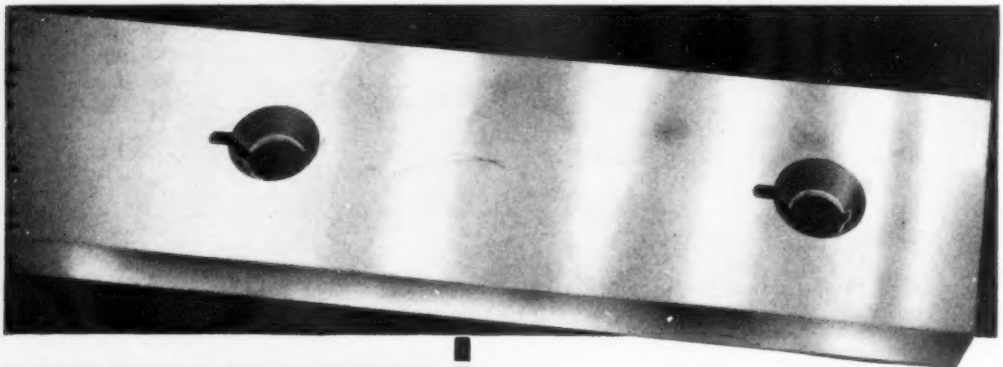

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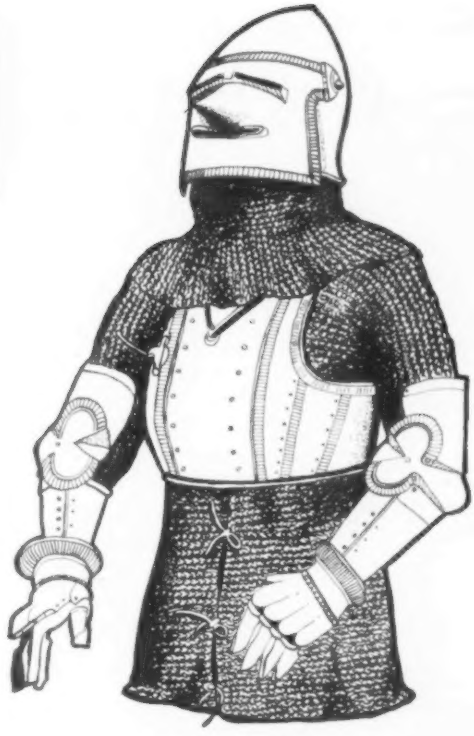

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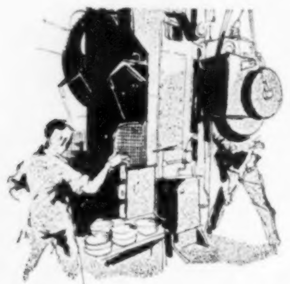

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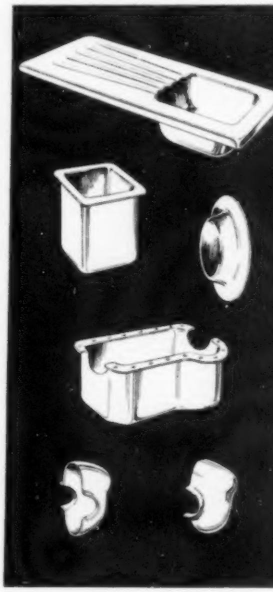

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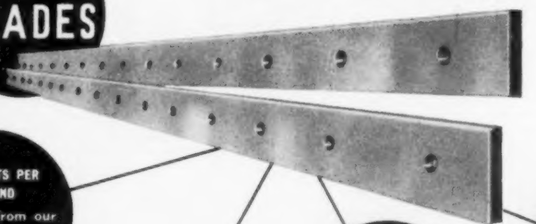

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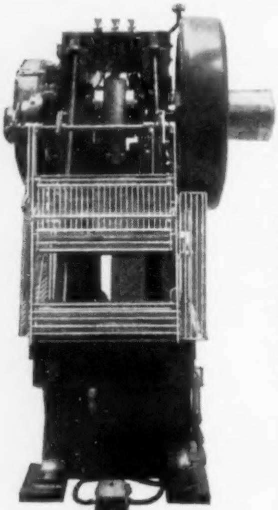

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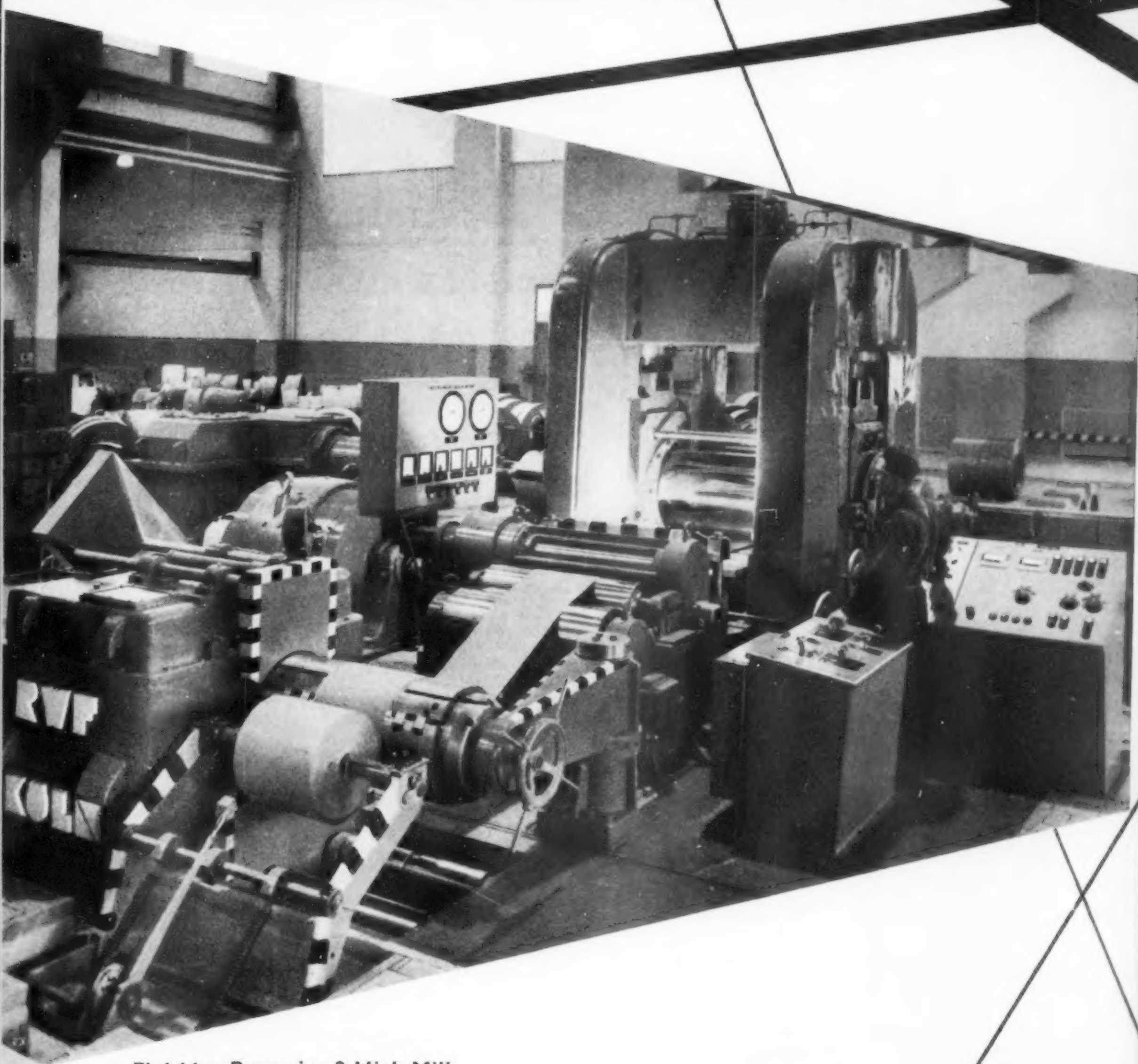
RWF
KÖLN

CLUES ACROSS

1 Animals have fun with the A.A. (5)
7 Breezy admirer (3)
9 Sort of ball for a rabbit (3)
10 What the successful advertising **29** must do (6)
13 Shapes served with prunes (6)
14 P.M. Attlee provided this pattern (8)
16 Anger characteristic of tool steel (6)
18 What a nerve you have to look! (5)
19 You get plenty of drive here (3)
20 Trimmed with deadly effect (11)
26 They are the very antithesis of cocky (4)
27 Not the sort of train you find on **34** (7)
29 See **10** (6)
30 On the edge of the North West Frontier (4)
31 Lands one in a sorry state (5)
32 **24** takes it down (3)
33 A touching sentiment (7)
34 Course of Egypt's river (4)

CLUES DOWN

1 Our Air Force goes up a great distance (3)
2 Theatrically stand-offish (7)
3 We have the one for strip (4)
4 The old Service got a rise in 2 (3)
5 Char, of a sort, chum (4)
6 A safe one must be steel (7)
7 Even makes the spread (10)
8 Her parents cannot both be only children (5)
11 Parrot feed mixture (10)
12 Highland pasture (3)
15 Connect an article of apparel (3)
17 Break away, and so manage to win (4, 3)
21 Characteristic of Anon's composition (8)
22 Boasts unbroken coastline (4)
23 Number found in Spion Kop (3)
24 Put the weight—but back in first (5)
25 Time for Bill to get paid (3)
26 The old witch broke her leg into the bargain (6)
28 Therein without getting thin (3)
32 Money for plate you use (3)

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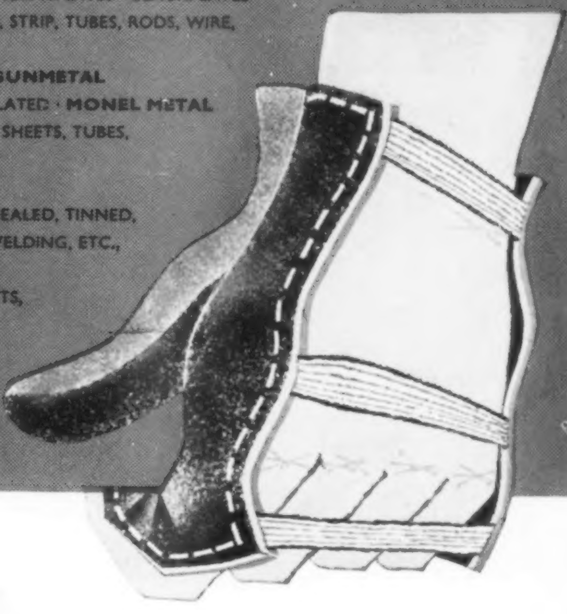

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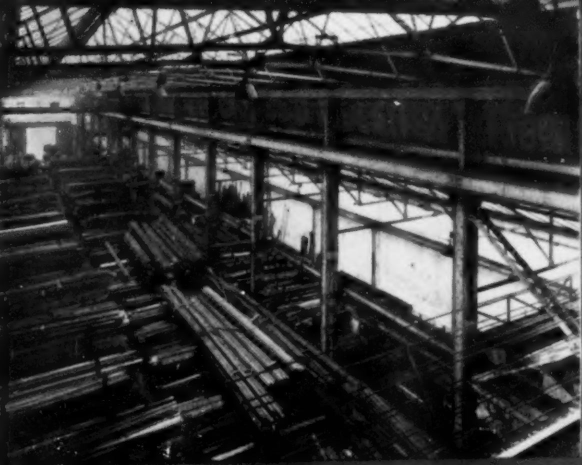

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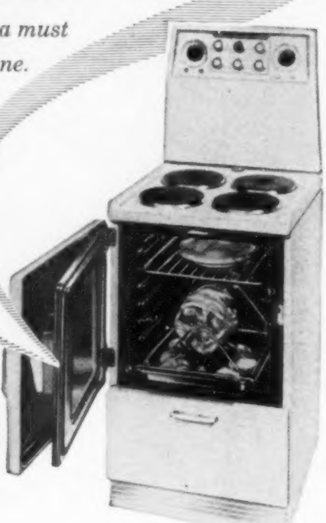

And the Creda designers know what they're talking about. In every modern product a good deal of thought goes into the problem of fastenings, and designers find that it pays to call in a Spire representative at the early design stage. He's a fastening specialist, and a chat with him can save you pounds, by speeding up your assembly and by keeping production costs down.

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Other capacities on short delivery.

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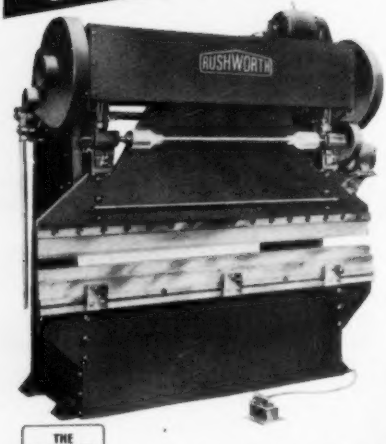

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Greatly increased life

of bogie suspension unit with BLACK-MOLY

REMARKABLE REPORT FROM
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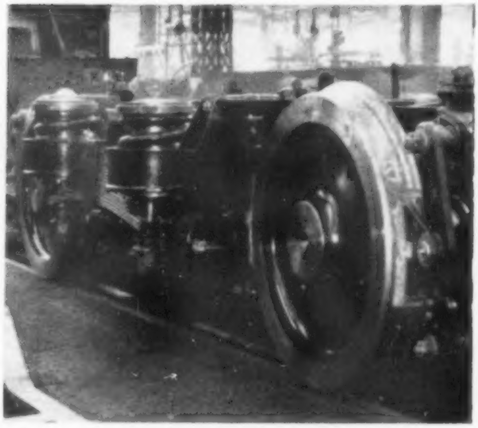

Severe scuffing had been experienced on the insides of coil spring guides on Diesel Locomotives, caused by heavy metal to metal contact. Tests were commenced using BLACK-MOLY Molybdenised Lubricants, and after complete treatment these Bogies were put back into service.

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This treatment with
BLACK-MOLY
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★ LUBRICANT GRADES USED WERE:

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Steel, in fact, made precisely to your particular measure.

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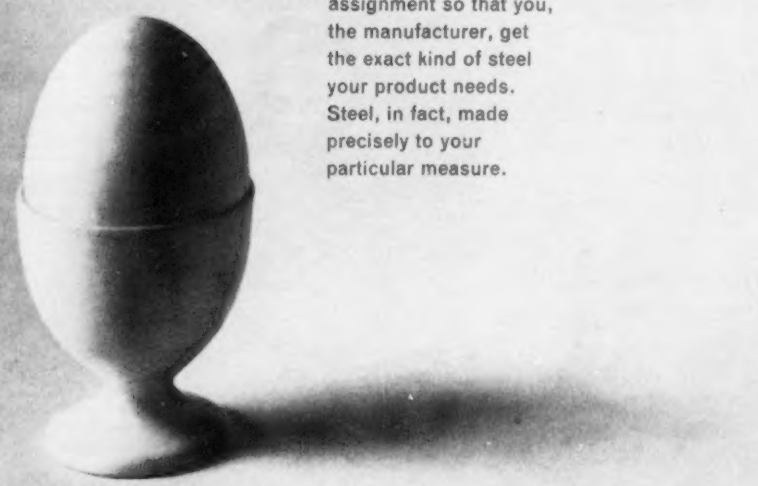

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Restrainers in acid pickling for ferrous metals

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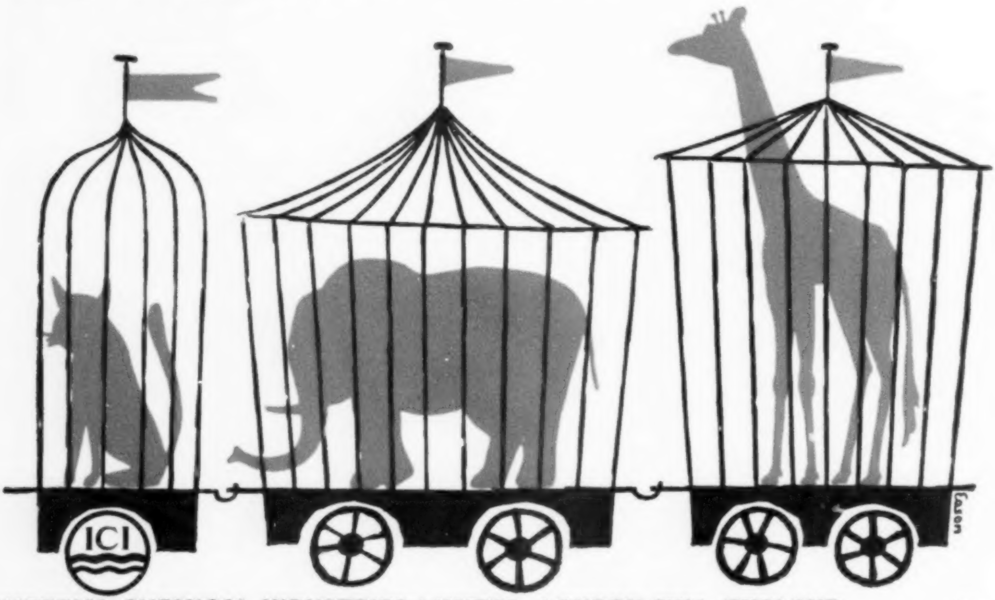

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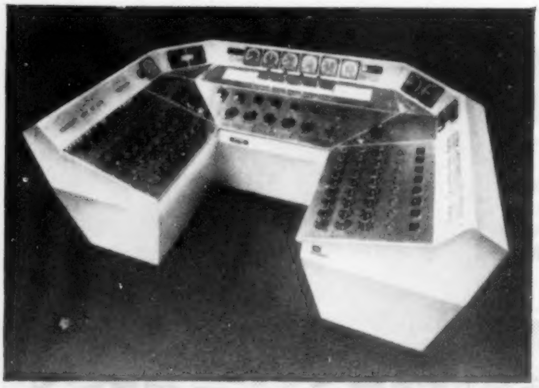

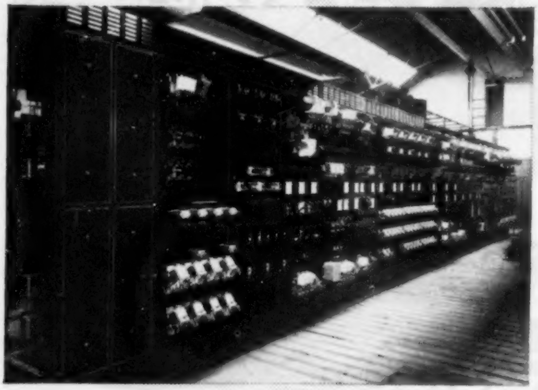

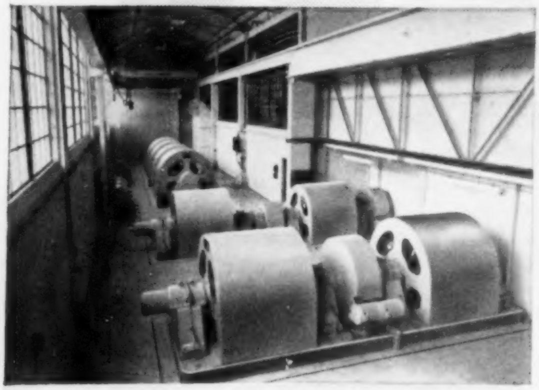

Hand in Hand . . . An Agreement has been concluded

between Bruce Peebles & Co. Limited, of Edinburgh, and REGA Brucker & Co., of Siegburg, Germany, for the joint production and marketing of complete electrical equipments for the operation and control of ferrous and non-ferrous hot and cold rolling mills. This agreement unites in this field the resources of these two well-known organizations, each of which has had extensive experience in the design and manufacture of electrical equipment incorporating the most advanced techniques in the specialised rolling field.

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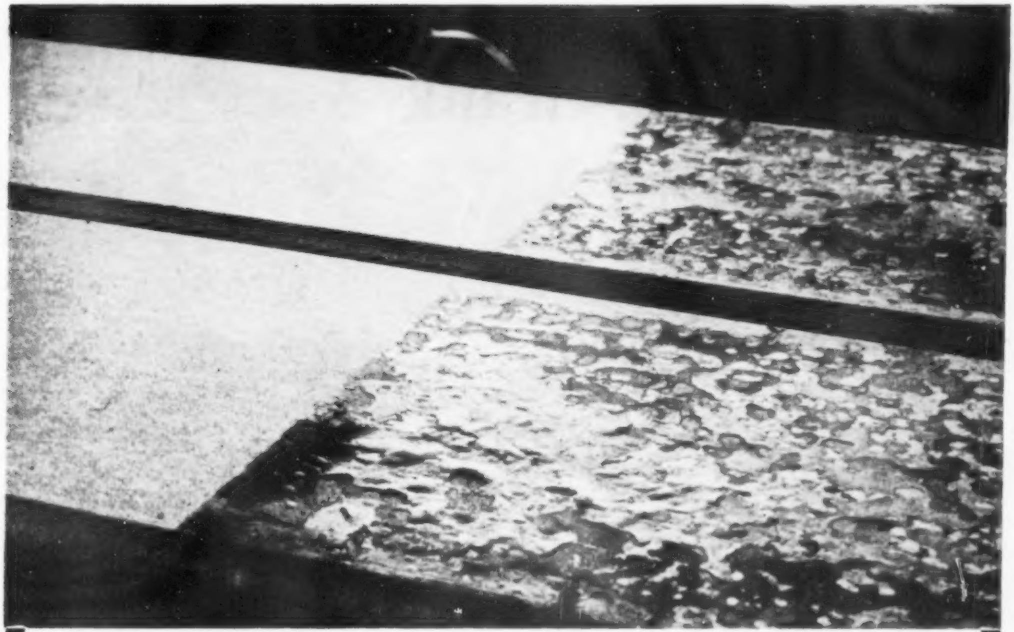
Among the activities already in progress are contracts entailing full responsibility for the complete electrical equipment for several rolling mills.

MILLS

Cardiff Office: Park Chambers, 1 Park Place

BRUCE PEEBLES EDINBURGH

REGA



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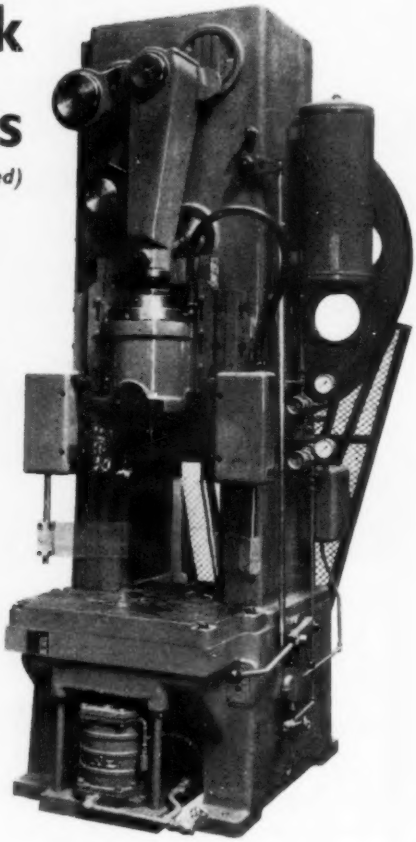

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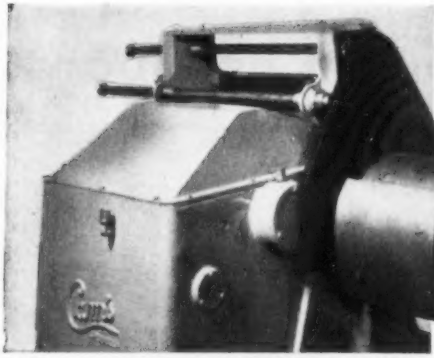

Cam's
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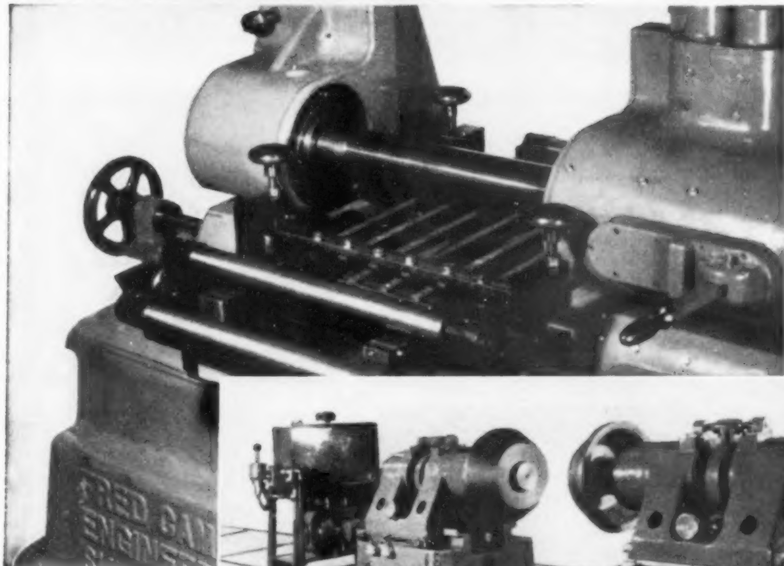
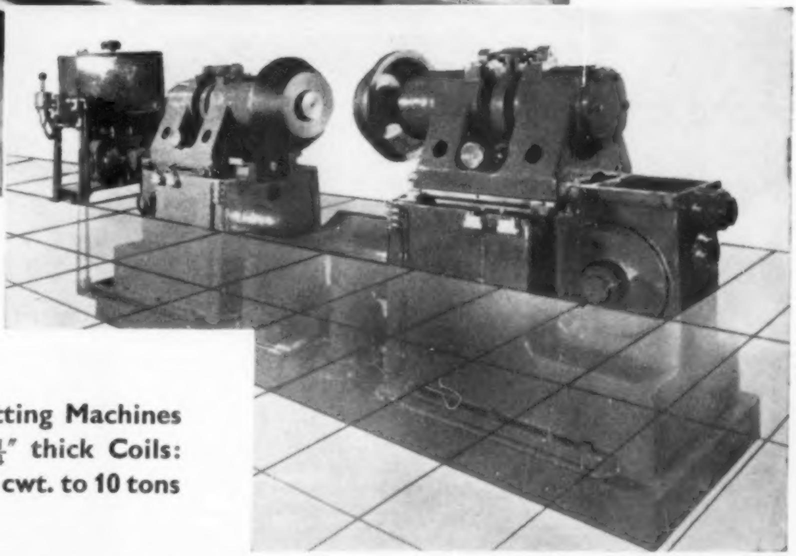
SHEFFIELD

Auxiliary Equipment for Strip Mills, Box and Tube Works





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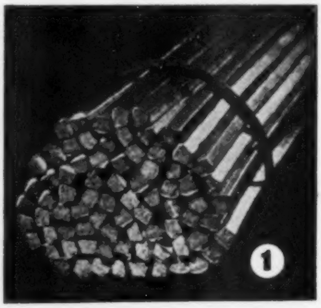

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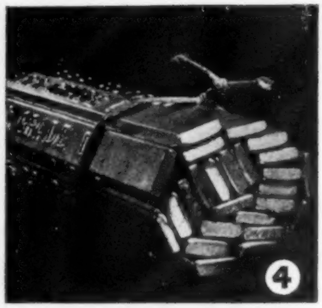

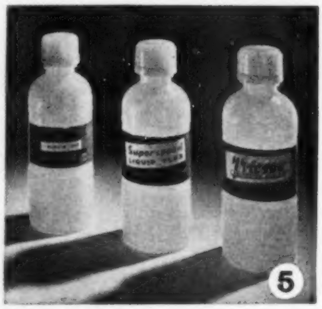

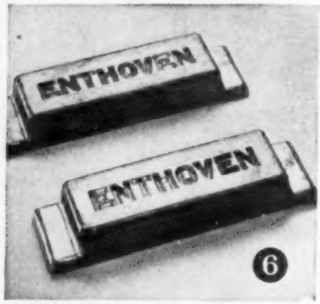

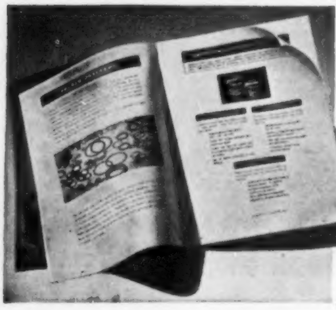

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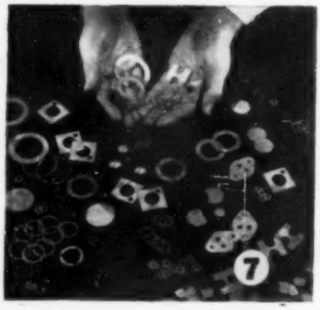


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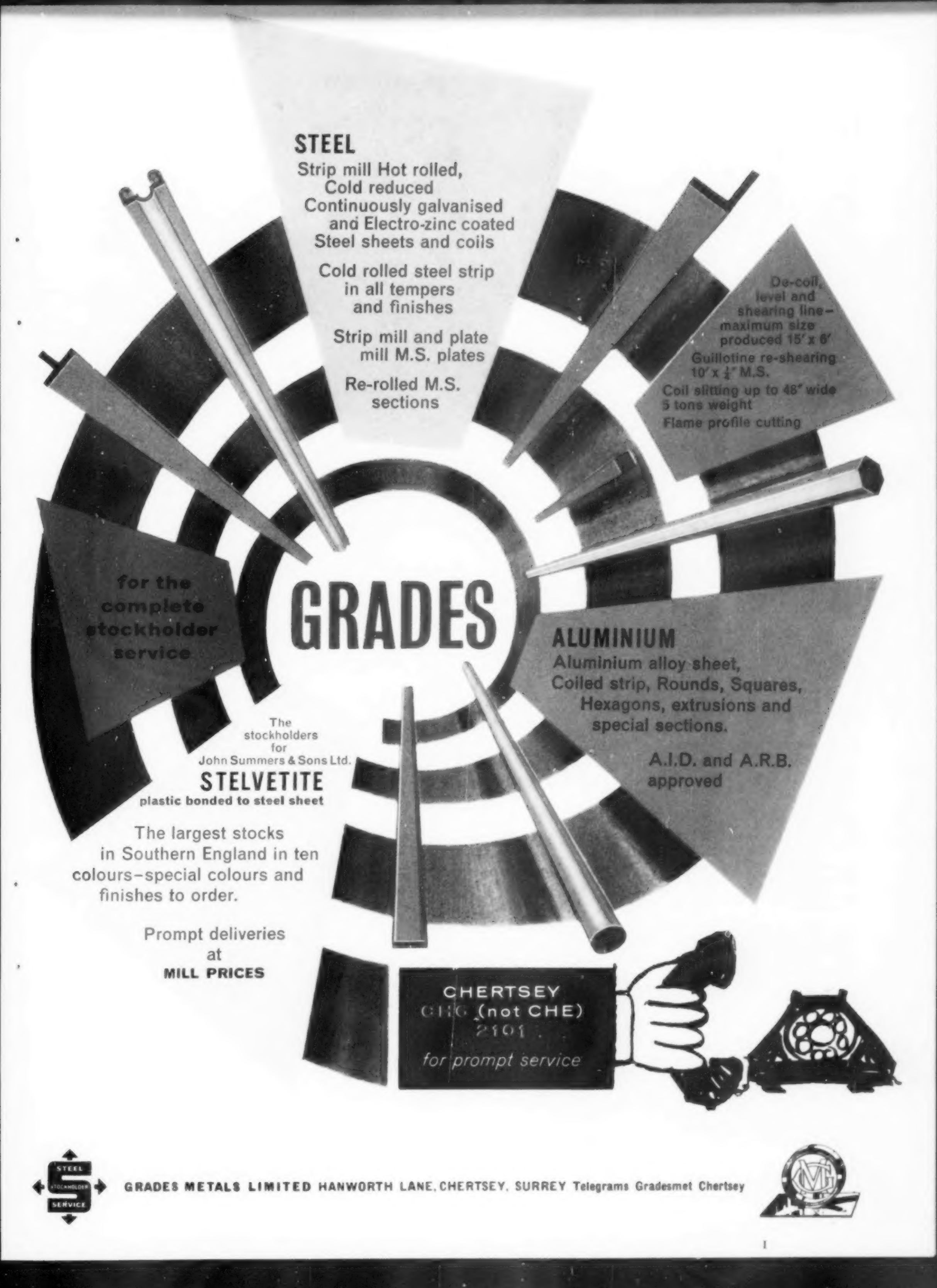
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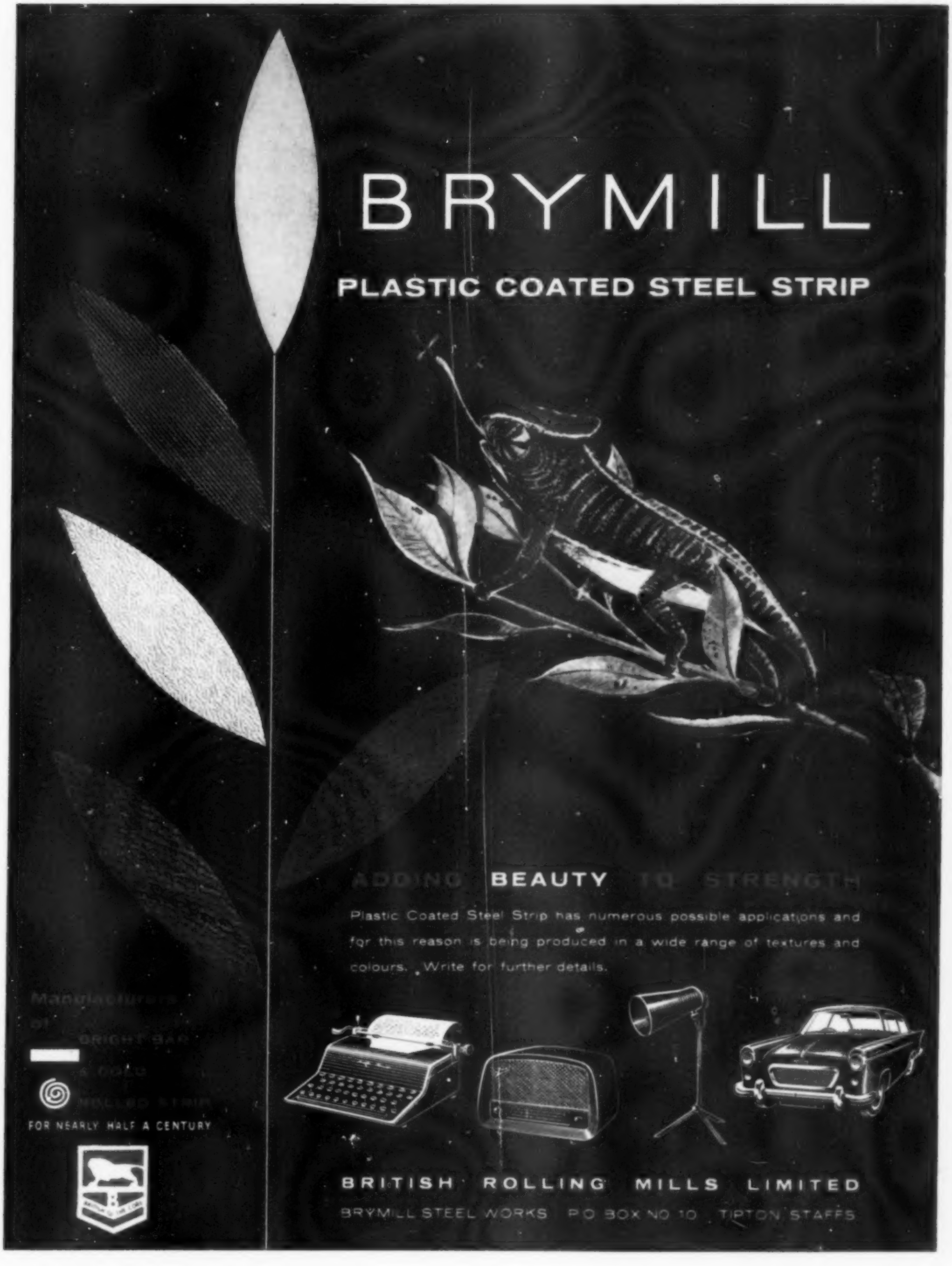
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RÉSUMÉS DES PRINCIPAUX ARTICLES

Procédés de Production à l'Usine Beacon de la Société John Thompson Motor Pressings Ltd.—6 .. page 482

Ce chapitre fait la description de la construction des chassis et organes, fabriqués avec des matériaux de fort calibre. Cette phase des travaux de la société comprend les chassis très lourds pour les voitures de voyageurs et les wagons-diesels des chemins de fer, les portes des wagons à minerai et divers pièces pour les industries ferroviaires et automobiles.

La fabrication des chassis de vehicules commerciaux exige des méthodes qui diffèrent de celles qui sont employées à la production des chassis automobiles, du fait de l'augmentation de la longueur, de la profondeur et des specifications des materiaux utilisés. Il est fait une description de ces méthodes et des détails de la fabrication ainsi que de l'emploi de jeux de matrices reversibles servant à la production des longerons latéraux.

Les operations d'emboutissage à chaud et à froid sont décrites et des renseignements sont donnés au sujet du finissage des chassis par pulverisation à chaud et rinçage, ou au moyen du nettoyeur Wheelabrator à grains abrasifs sans air.

Economie de Pression page 493

Par Melvin D. Verson

Ce mémoir, présenté à la conférence spéciale au sujet du "Refoulage à Froid de l'Acier," organisée par l'Institute of Sheet Metal Engineering (Institut des Ingénieurs-Tôliers) traite l'usinage par percussion, soit le refoulage à froid porté, en principe, jusqu'au point ou le finissage à l'outil n'est plus nécessaire. Outre la description des presses convenables et de leur conception, ce mémoir renseigne le lecteur sur les systèmes de lubrification, les aciers à outils etc. Il est complèté par le complte rendu du débat qui en a suivi la présentation.

Conception et caracteristiques des Presses Mecaniques page 501

Par E. Hamilton, A.M.I.Mech.A.

Cet article est basé sur une conférence faite par l'auteur au Wolverhampton and Staffordshire College of Technology, dans la serie intitulée "Tech-

(*Suite page* 540)

ZUSAMMENFASSUNGEN DER HAUPTARTIKEL

Produktionsverfahren im Werk Beacon der John Thompson Motor Pressings Ltd.—6 .. .. Seite 482

Diese Fortsetzung beschreibt die Herstellung von Rahmen und Einzelteilen aus stärkerem Material. Dieses Arbeitsgebiet der Firma umfaßt die sehr schweren Rahmen für Eisenbahnpersonenwagen und Diesellastwagen Erzwagentüren und eine Anzahl verschiedener Erzeugnisse für die Eisenbahn- und Kraftfahrzeugindustrie.

Die Herstellung von Lastwagenrahmen erfordert wegen der größeren Länge, Tiefe und der unterschiedlichen Materialien andere Fertigungsverfahren wie die von Fahrgestellen für Personenkraftwagen.

Diese Verfahren werden beschrieben und Einzelheiten über Herstellung und Gebrauch der zur Fertigung langer Seitenholme dienenden umkehrbaren Werkzeugsätze angegeben.

Die Warm- und Kaltverformungsvorgänge werden beschrieben und Angaben über die Oberflächenbehandlung von Rahmen durch Heisspritzen und Spülen oder mit Hilfe eines Wheelabrator Sandstrahlgläses ohne Preßluft gemacht.

Okonomie im Pressen Seite 493

Von Melvin D. Verson

Diese Abhandlung, welche anläßlich der Sonderkonferenz über das „Kaltpressen von Stahl" vom Institut der Blechverarbeitenden Industrie veranstaltet wurde, behandelt „Schlagbearbeitung", wobei Kaltpressen im Grunde zu einem Punkt gebracht wird, bei dem Oberflächenbearbeitung unnötig wird. Diese Abhandlung gibt, abgesehen von der Beschreibung hierfür geeigneter Pressen und deren Konstruktion, Aufschluß über Schmierungsarten, Werkzeugstähle, u.s.w. Hierauf folgte eine Diskussion, die nach der Darbeitung stattfand.

Konstruktion und Eigenschaften von Pressen .. Seite 501

Von E. Hamilton, A.M.I.Mech.A.

Dieser Artikel basiert auf einer vom Verfasser in der Reihe „Die Technik des Tiefziehens und Pressens" am Wolverhampton and Staffordshire College of Technology gehaltenen Vorlesung. Er beschränkt sich auf

(*Forts. S.* 540)

RÉSUMENES DE LOS ARTICULOS PRINCIPALES

Procedimientos de producción en los Talleres Beacon de la John Thompson Motor Pressings Ltd.—6 página 482

Este capítulo describe la fabricación de bastidores y elementos elaborados con materiales de calibre más grueso. Esta fase del trabajo de la compañia comprende los bastidores de gran calibre para vagones de ferrocarril para pasajeros y camiones diesel, puertas para vagones para el transporte de minerales y multiples otros elementos para las industrias del ferrocarril y del automóvil.

La producción de bastidores para vehículos comerciales exige métodos diferentes de fabricación de los empleados para chasis de automóvil, debido al mayor largo, la mayor profundidad y las especificaciones de materiales exigidas. Se describen estos métodos y se dan detalles sobre la fabricación y uso de juegos reversibles de troqueles que se emplean en la producción de largueros largos.

Asimismo se describen las operaciones de formación en frio y en caliente y se ofrece información en lo que se refiere al acabado de los bastidores por roció caliente y enjuegue o por medio de la instalación de limpieza "Wheelabrator" por chorro abrasivo sin aire.

Economia de presión página 493

Por Melvin D. Verson

Esta ponencia, que fué presentada durante la conferencia especial sobre "Extrusión en frío del acero", organizada por el Institute of Sheet Metal Engineering (Instituto de Ingenieria de la Chapa Metálica), trata del "labrado por impacto", la extrusión en frio básicamente llevada a cabo hasta el punto de eliminar el acabado a máquina. Ad^más de describir prensas adecuadas y su concepción, la ponencia ofrece información sobre sistemas de lubricación, acero para herramientas, etc. Sigue la discusión que tuvo lugar después de la presentación.

La Concepcion y las Caracteristicas de las Prensas Mecanicas .. página 501

Por E. Hamilton, A.M.I.Mech.A.

Este articulo se basa sobre una conferencia dada por el autor en la serie

(*Continuara en p.* 540)

Sheet Metal Industries

Incorporating PRESS TOOL ENGINEERING

Official Organ of the following Associations:

INSTITUTE OF SHEET METAL ENGINEERING
President: Mr. F. W. Hancock, O.B.E. *Chairman:* Mr. A. E. Gilbert
Hon. Secretary: Mr. John Hooper, John Adam House, 17-19 John Adam St., Adelphi, London, W.C.2. Tel.: TRAfalgar 6171 (P.B.X.)

SHEET METAL INDUSTRIES ASSN. LTD.
Chairman: Mr. H. R. Trost
Secretary: Mr. A. E. Ward, F.C.I.S., 68 Gloucester Place, London, W.1. Tel.: HUNter 1945.

STAINLESS STEEL FABRICATORS' ASSN.
Chairman: Mr. K. Liversidge.
Secretary: Mr. F. J. Winfield, Chamber of Commerce, P.O. Box 360, 75 Harborne Rd., Edgbaston, Birmingham, 15. Tel.: EDGbaston 6171

BRITISH POWER PRESS MANUFACTURERS' ASSN.
Chairman: Mr. H. D. Challen
Secretary: Mr. G. T. Beach, Standbrook House, Old Bond Street, London, W.1. Tel.: HYDe Park 3451.

COLD ROLLED SECTIONS ASSN.
Chairman: Mr. D. L. Bates
Secretaries: Frank Impey & Co., Lombard House, 144 Great Charles Street, Birmingham, 3. Tel.: CENtral 2073.

COLD ROLLED STEEL STRIP ASSN.
Chairman: Mr. L. G. Firth
Secretary: Mr. R. T. Tarrant, Steel House, Tothill Street, London, S.W.1. Tel.: WHItehall 1030.

PROGRESS OR ROUT?

AFTER the last war the British iron and steel industry began a vast re-equipment and modernization programme (a programme that is still continuing), and at about the same time it became apparent that the industry's research effort also required to be expanded. Although several companies already operated their own research organizations it was evident that many problems could best be tackled on a co-operative basis and thus the British Iron and Steel Research Association came into being. Today, the Association has five divisions, broadly corresponding to the natural structure of the industry and three departments carrying out, in general, fundamental research.

The "pattern" of the Association's approach to serving the industry is to decentralize its efforts as much as possible so that research facilities are located in close proximity to centres of iron and steel production, so encouraging, it is said, an interchange of experience, etc., through close co-operation between research and production.

But the problem of deciding what research or development work is to be undertaken must be a difficult one, although, in theory at least, B.I.S.R.A. work ought to be related to the needs of the industry as many of its representatives serve on the various research committees, etc.

And yet, at the recent open day held at the Sheffield Laboratories of the Association, it appeared that as far as the sheet-metal-using industry is concerned the proportion of investigations directly related to its field were relatively low. From the Association's annual report for 1960 (extracts from which are published elsewhere in this issue) the apparent "out-of-balance" of the research programme can be seen, but an examination of material already published by the Association together with an appraisal of its various panels and research committees shows this trend still more. For example, out of about 240 reports only about 10 per cent are devoted to the production of sheet and its subsequent forming. The same ratio also applies to the panels and research committees. But the conversion ratio of sheet steel to finished products is the highest of any of the forms in which steel is marketed.

It is not the intention in any way to criticize the value of the individual researches being undertaken but only to sound a note of warning. In the U.S.A. there is at present a great deal of money being devoted to the exploitation of competitive materials in fields which are traditionally those of steel and it is not too fantastic a forecast to suggest that a similar situation may arise here. In any case the march of progress in itself must inevitably see increasing use of alternative materials and this is as it should be. But the country's economy depends so much on steel that it behoves the industry, and thus its research organization, to ensure that *new* uses for its products, the price of which must remain competitive, are not overlooked.

The march of progress must be orderly to the benefit of all industries; failure to appreciate future trends can only turn it into a rout.

Production Procedures at the Beacon Works of

JOHN THOMPSON MOTOR PRESSINGS Ltd.

THIS series has, until now, described those manufacturing processes at John Thompson Motor Pressings Ltd. in which relatively light-gauge materials are used. There are, however, extensive facilities at the works that enable the company to fabricate from heavier-gauge materials and in this field a wide range of items for commercial vehicles are manufactured including frames for railway trucks, passenger coaches and diesel units, and also chassis frames for a variety of passenger-carrying road vehicles. In addition a miscellany of pressings for the motor and railways trades are undertaken including mineral wagon doors, and panels for goods wagons and electric motor casings.

The finishing of the frames is purely a matter of the customer's requirements, and a number of cleaning operations are available on demand.

The manufacture of commercial-vehicle frames requires different methods of production to those employed for passenger vehicles. Unlike the car frame, the commercial frame must be capable of carrying heavy loads on a wheel base which in many cases is twice as great as that of a car frame, and must also have extra built-in strength to deal with intermittent or persistent overloading.

As a result of these extra load-carrying requirements, it is easily seen that with increased loads and longer wheelbase, the bending- and shear-stress values are much greater, and can at times be unevenly distributed as a result of a heavy concentrated load or a badly distributed load.

Correct use of beam theory, bending and strain energy equations at the design stage give the correct dimensions to deal with this high variable type of loading, but the increased length, depth, material specifications and thicknesses involved prohibit the use of blanking and cold-forming techniques used on the more conventional car frames. The number of commercial frames required at any one time is also very much less than that of the passenger cars and is another reason, one of economics, why the use of double dies is precluded. The problem is overcome at John Thompson Ltd. by building reversible die sets, which are used to form a batch of members for one hand, after which the punch and die are re-assembled and a batch of members for the opposite hand produced.

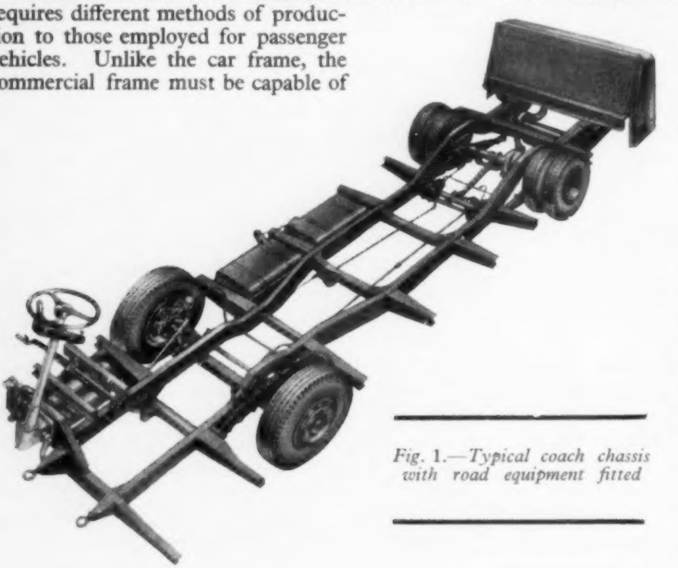


Fig. 1.—Typical coach chassis with road equipment fitted

The problem of producing these frames economically influences the methods of production, not only in the press shop but throughout the factory. Assembly of the main frame is generally effected by riveting, although welding is widely used to fabricate cross-members and to attach doubling

6

(*Series continued from page* 333, *May*, 1961)

The Manufacture of Commercial-Vehicle Frames

(*above*) *A.E.C. diesel 'bus*

channels or plate stiffeners to sidemembers. The frames can be supplied to the customer in either component form, where the final riveting or bolting is done at the customer's works, or fully assembled.

As in all frames the most important component is the sidemember and the materials most commonly used in its production are 28/32-ton mild steel, STA5/V4 30 carbon steel or STA5/V6A 35/43-ton carbon-manganese steel in plate of from $\frac{3}{16}$-in. to $\frac{1}{2}$-in. thickness. The ordering of these plates is done so that the sizes are related as closely as possible to blank sizes to eliminate scrap.

Blanks and Shaping

John Thompson's produce frames for a wide range of trucks and coaches and in some cases, particularly the lighter vehicles where lighter materials can be used, the cost of die-making is not so high, and simple tools are used to blank side-members from plate up to $\frac{5}{16}$-in. thick. A 2,000-ton British Clearing press is used for these blanking operations and blanks up to 29 ft. in length can be produced. Examples of the blanking and cold-forming capacities of this press can be seen in Table I.

TABLE I

Mild Steel 28/32 tons per sq. in. tensile

Thickness, inches	Length of member that can be produced		Amount of shear required to blank member 29 ft. long (12-in. steelings)
	Straight	With kick-up	
$\frac{5}{16}$	23 ft. 0 in.	22 ft. 7 in.	0.80
$\frac{9}{32}$	25 ft. 8 in.	25 ft. 3 in.	0.62
$\frac{1}{4}$	29 ft. 0 in.	28 ft. 9 in.	0.50
$\frac{7}{32}$	29 ft. 0 in.	29 ft. 0 in.	0.37

For these long members the steelings of the dies are given a considerable amount of " shear."

For vehicles where the numbers of sidemembers required do not justify the making of die sets, the blanks are cut to shape on rotary shears. This method of producing blanks is usually used for producing shapes in heavier gauge material up to $\frac{3}{8}$-in. thick, although in some cases a guillotine is used for material up to $\frac{1}{2}$-in. thick. The shapes are marked on the plate from sheet templates and the plate is manipulated in the rotary shears by three or four operators. Where the material size exceeds $\frac{3}{8}$-in. the blanks are sometimes flame cut to a profile template.

Forming

Both hot- and cold-forming operations are effected, the cold-forming being limited to the lighter members up to 29 ft. long, in cold-forming

Fig. 2.—A wagon end made in two pieces and formed in three operations

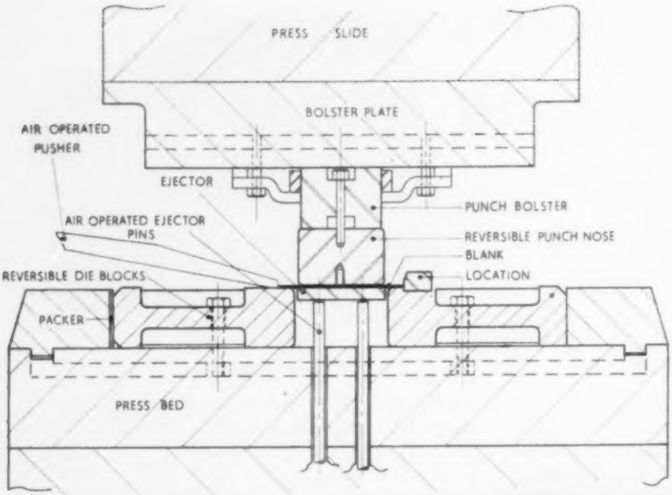
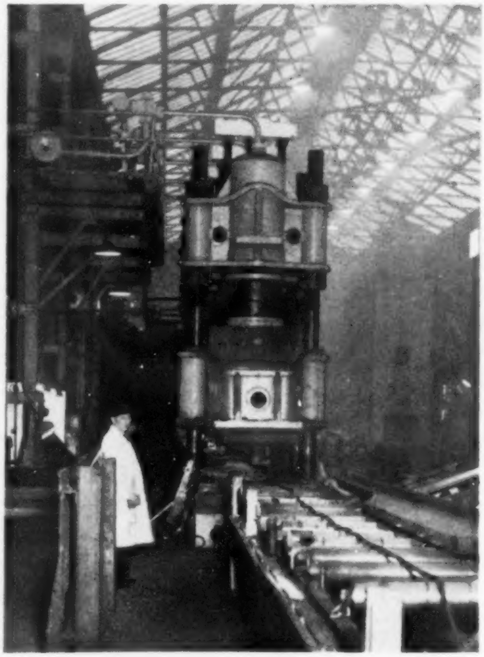


Fig. 3 (left).—Section through a typical tool for hot pressing side members, showing reversible die blocks

Fig. 4 (below).—500-ton hydraulic press, which has a pivoting table from the furnaces, so that continuous production is possible

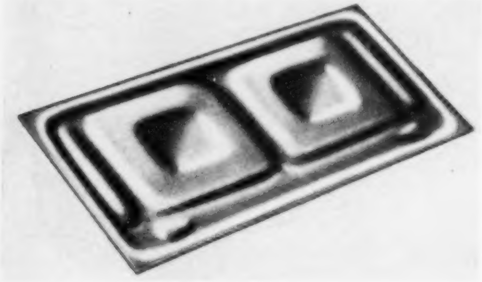


and alloy steels, and carried out in mechanical presses. Members fabricated in heavier gauge material are hot-formed in hydraulic presses designed and manufactured by John Thompsons.

The press used mainly for hot pressing side-members is a 1,500-ton hydraulic press which was completely rebuilt in 1958. The rebuild allowed the incorporation of chromium-plated rams and a new type of bed incorporating pneumatic cushions. Additional facilities include equipment for the mechanical handling of blanks, and loading aids and automatic position locators are of John Thompson design.

Twenty-four die cushions, each 10 in. in diameter, work a platen which operates striker pins, this system being adopted because of lack of space. An air-operated pusher is used to move the blank up to the locating device. Secondary ejectors are provided under the bed of the press, these being used for bringing the blank in and out and for ejecting after pressing. The maximum length of pressing produced on this press is 36 ft. 10 in.

Fig. 5.—Wagon door end produced from hot-pressed mild steel



The die cushions allow the production of straighter pressings with really square flanges, together with higher output, which is possible because the pressings are ejected hot instead of cold as was previously the case.

Special provision has been made for quick removal and positioning of tools. For heating

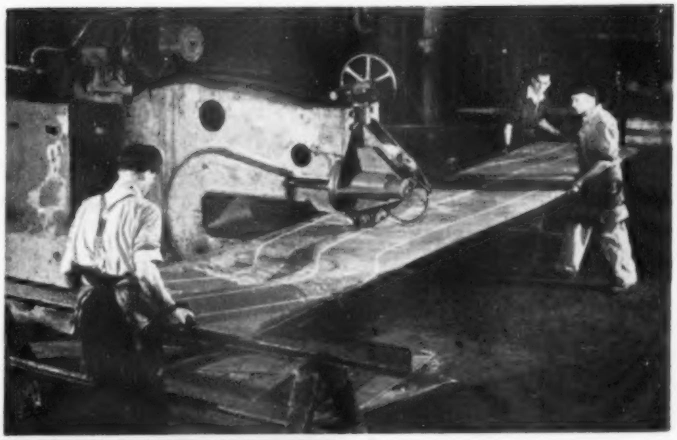


Fig. 6 (right).—Rotary shears used for producing shapes in heavier-gauge material up to ¾ in. thick

Fig. 7 (left).—After pressing the upper flange and web of the side members are straightened with an hydraulic straightening press

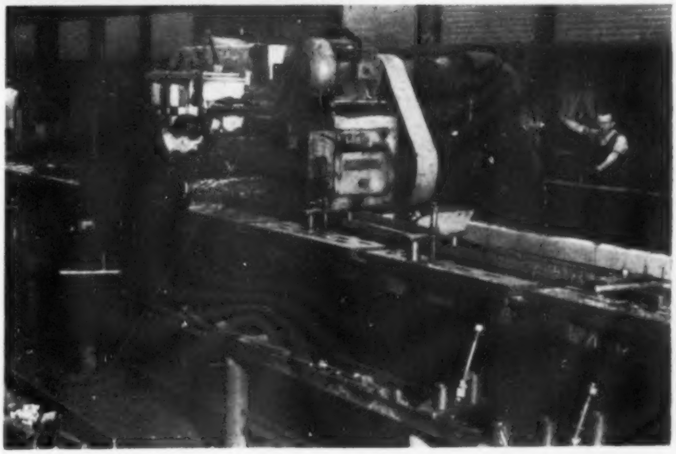


Fig. 8 (right).—A Wadkin spar miller is used to mill the flange to the design width. The head of these machines has a total travel of 33 ft. and takes a cutter up to 24 in. long

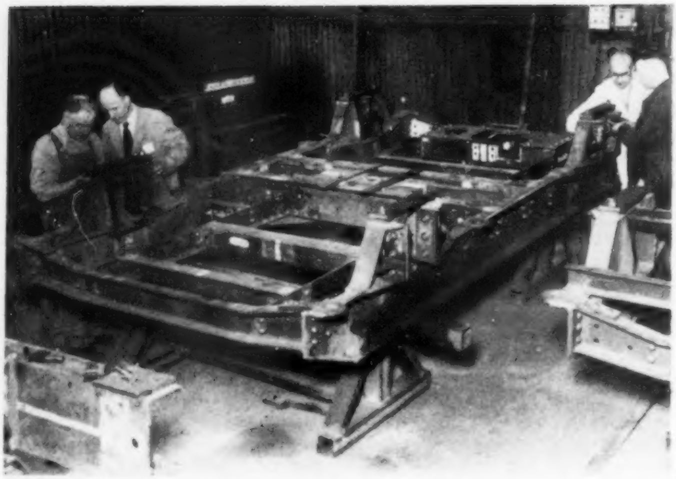


Fig. 9.—Following milling, the top face profile, squareness of the web and flanges, are checked and any deviations corrected by cold hand setting

the blanks before pressing a pivoting table is provided in front of two furnaces, so that continuous production is possible.

Each furnace can reach 1,200° C. but is normally run at 1,000° C. giving a pressing temperature of about 850° C. and the handling equipment ensures that the temperature is not lower than that figure.

After pressing, the blanks pass on to the loading platform of a cooling conveyor, the pressings then being pushed into position by air cylinders onto a moving chain conveyor which carries them through a cooling stage and discharges them automatically into storage cradles. The complete set-up is controlled from the press operator's master panel.

The equipment produces distortion-free pressings and final setting of the frame elements is very much reduced.

In a typical set of tools for forming sidemembers straight in a vertical plane, the punch and the die are built up in sections, having two straight and parallel sections which can be removed as required for vehicles of differing wheelbase. The punches are radiused on both upper and lower edges and the die sidepieces have the standard entry chamfer at the top and bottom edges. This, of course, enables the single tool set to form both right-hand and left-hand members. The punch sections are secured on a bolster and the die sidepieces are assembled in the trough of the press and supported transversely by packings against the sides of the trough.

When a run is completed and a batch of members for one hand obtained, the tools are dismantled from the press and reassembled in an inverted position so that the members of the opposite hand can be formed. It will be appreciated that this method of forming both hands of the sidemember can only be effected when the members are straight in a

Fig. 10.—The centre section is strengthened if required by welding or riveting flitch plates, doubling channels, or welding perforated box plates to the edge of the flanges

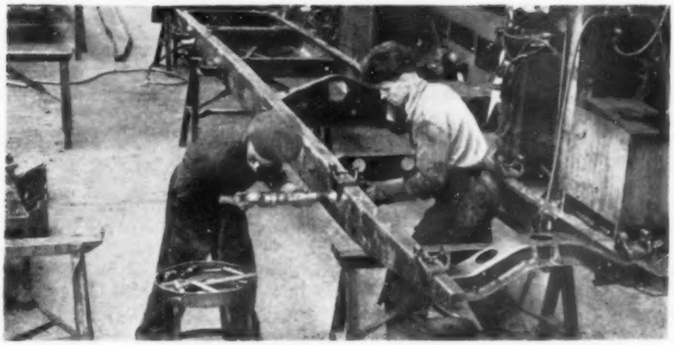


Fig. 11.—The side members are mounted on trestles and the various crossmembers and gusset plates are attached by rivets, heated electrically and set by a pneumatic hammer

vertical plane, as mentioned earlier, and that all sidemembers having joggles would necessitate a set of tools for each hand, it is, therefore, arranged that all joggles are effected at a later stage.

Setting and Machining

The sidemembers are normalized and straightened on the web and upper flange with hydraulic straightening presses. The flanges are then milled on a Wadkin spar miller to the design width. The head of these machines has a total travel of 33 ft. and takes a cutter up to 24-in. long. The length of the cutter is sufficient to cover the kick-up of any normal sidemember or two straight members, in a single pass. The work is held down to the table by means of eight pairs of hydraulic clamping cylinders, and as the cutting head approaches any pair of clamps, a trip lever relieves the pressure and the out-of-balance dogs fall out of the cutter path. Once the head has passed, the pressure in the clamps builds up and the dogs are automatically repositioned and clamped on to the work.

Following the milling operation comes the all-important top face profile check. This check is most important as any deviation from the design can offset the section modulus of the sidemember and thus alter its bending properties. The squareness of the web and flanges is checked and also the contour and deviations corrected cold by hand setting. The parallel centre section is then strengthened if required by welding or riveting flitch plates, or doubling channels may be welded or riveted to secure. In some cases strengthening is obtained by welding perforated box plates to the edge of the flanges, to give a complete box section.

Like the passenger-car frames, an effort is made to minimize the amount of handling required, and sidemembers are drilled at one setting on full length tables specially built with this in mind. Motorized drills, of $\frac{3}{4}$-in. capacity, are arranged on twin T-section rails running above and to the rear of the table. The number of drills varies with the type of chassis being drilled, and the rails are capable of taking any convenient number. Each drill can be adjusted in a transverse direction enabling holes to be drilled in any position across the member, and they are also movable in a longitudinal direction along the whole length of the member. Drilling jigs are available where members of one particular

(*Continued in page* 514)

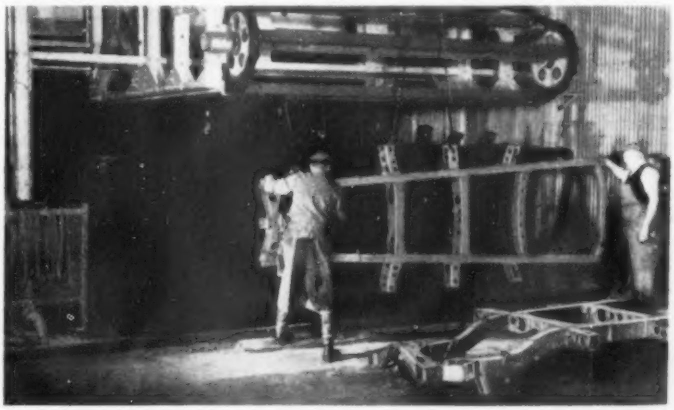


Fig. 12.—The enamelling plant, manufactured by Carrier Engineering Co. Ltd., lowers chassis up to 20 ft. long into a bath of enamel and conveys them through a stoving plant

BRITISH IRON AND STEEL RESEARCH ASSOCIATION

Some Extracts from the Annual Report, 1960

MECHANICAL WORKING DIVISION
Sheet and Strip Manufacture

Hot Rolling

YIELD-STRESS data for three further steels, Cor-ten, Fortiweld and Fortiweld H.S., have been obtained and have been published in the same format as those for the 12 steels issued earlier in the volume " The calculation of load and torque in hot flat rolling."

Pickling

The removal by pickling of the edge scale on both wide and narrow mild-steel strip may take up to three or four times as long as the centre scale, thus wasting both acid and metal, since the centre of the strip is inevitably over-pickled. Mechanical scalebreaking shortens the pickling time only marginally. Examination of narrow strip has shown that a film of Fe_2O_3 is formed on the rolling scale near the edge during the slow cooling of the strip after coiling, and though this oxide has not yet been positively identified on wide strip it seems probable that it is the cause of slow pickling. One way of preventing the formation of this film, by sealing the edges of the hot coil with boric oxide after it has been taken from the coiler, has been tried out in two mills and shown to be successful in bringing the pickling time of the edges of the strip into line with that of the centre. The spraying of boric oxide is unacceptable under production conditions, but other possibilities of bringing about the desired effect exist and their merits are being looked into.

Cold Rolling

The assessment of a series of 11 experimental rolling oils on the 14-in. laboratory mill has been completed. None of the experimental oils has proved better than palm oil.

At the same time research into the mechanism of lubrication has demonstrated the possibility of reducing friction and wear by grinding the rolls transversely instead of circumferentially as is done at present. Pilot experiments on a production mill have shown that although the experimental finish disappeared after only a few coils had been rolled, the roll wear between dressings was greatly reduced and the final appearance of the worn roll was conspicuously better. More extensive tests are being arranged in collaboration with member firms, and machine-tool makers are being asked to help devise practical methods of obtaining this finish in industrial roll dressing shops.

During the rolling of thin, hard strip in recent trials on the experimental mill, it was found that occasionally, if two different gauge strips were entered into the finishing pass at the same screw setting, the heavier inlet gauge produced the lighter finishing gauge. Indeed, although it proved impossible to roll to 0.0035 in. from 0.006-in. strip, no difficulty was experienced in obtaining it from 0.008 in. This may be a reason why tinplate-mill operators favour a heavy finishing draft, and a more thorough study of the mechanics of rolling in these conditions is under way, with reference to the rolling of ultra-light gauges.

In order to improve automatic gauge-control systems, the Physics Department is determining, on a 4-high production tandem mill, the coefficients that describe the response of a millstand to changes in rolling conditions. A new non-contact strip speed meter is also being developed.

Annealing

Can-making trials with material annealed on the 5-in. gas-fired plant at Sketty Hall confirmed that the properties of temper universal for tinplate can be achieved with a processing time of less than 10 seconds. The opportunities for rapid heating and cooling at higher strip speeds have now been exploited in a more advanced experimental plant, also for 5-in. wide material. The strip is preheated in a tank of lead/bismuth eutectic, passes through an electric induction heater, and is cooled in a second tank of the liquid metal. The two tanks are connected by ducts, and the metal is circulated by an electromagnetic pump to maintain thermal equilibrium.

With this combination of heating methods an extremely compact plant has been designed ; it is easily controllable and has high overall thermal efficiency. The plant has many potential uses, and there are indications that tempers 5 and 6 for tinplate can also be made on it. A programme of tests is under way in conjunction with a can manufacturer. Apart from annealing, preliminary experiments on the 5-in. line have suggested that blueing might be effectively and economically carried out.

The first pilot production plant is now being planned for installation at a member's works. This will be capable of processing strip up to 27 in. wide on an experimental basis.

Progress has also been made in extending the rapid annealing cycle to thicker gauges of mild-

steel sheet and strip for drawing and stamping. Using the tinplate cycle as a starting point, mechanical properties comparable with those of batch-annealed drum stock have been obtained, except that the yield point was slightly too high. Several possible ways of rectifying this are being investigated, as are methods of producing the softer qualities for deep drawing.

Tinning

Earlier laboratory work at Sketty Hall showed that the rust resistance of thinly coated tinplate is much improved by an electrolytic smoothing treatment applied to the steel before coating. The process developed by BISRA is capable of reducing surface area by 30 to 40 per cent in about one second, and so can be incorporated in a production electrolytic tinning line. An effective pickle treatment is given during smoothing and the process can therefore be operated without plant modification.

The treatment has been tried on a production wide-strip electrolytic tinning line at 600 ft. per min., and the product passed for production can-making by a metal-box manufacturer. Because of the limitations on the particular line used for the trial, the optimum time and current density could not be achieved, so that the full benefit of smoothing has not yet been realized in production.

However, an appreciable amount of 5-in. wide tinplate has been produced under optimum smoothing conditions on the experimental electrolytic processing line at Sketty Hall, although before this could be done with intermittent running a number of innovations and improvements had to be made to the line. The quality now appears to be excellent, and the tinplate is being assessed by a can manufacturer. A licence has been granted to a plant maker who is planning to evolve production plating units from the BISRA design.

Work has continued in the Physics Department on instruments for the inspection and grading at high line-speeds of tinplate and uncoated strip, and a lamination detector has been developed in conjunction with an instrument manufacturer.

Electrophoretic Deposition of Aluminium

Good progress has been made on the development of a process for coating strip with aluminium by electrophoretic deposition of aluminium powder followed by rolling and heat treatment. The work up to the present has been confined to the production of small samples, but a 5-in. experimental line is now being constructed at Sketty Hall in order to make material for user assessment, and to work out technological details.

When produced under the optimum conditions, the properties of the new aluminium-coated steel (Elphal) are most attractive. The coating is uniform and thickness can be controlled to fine limits over a wide range. There is very little alloy present, and porosity is so low that the surface can be anodized. The steel can be quite severely deformed without any deterioration of the coating. The raw aluminium powder costs 50 per cent more than the ingot aluminium used in hot dipping, but this is offset by the fact that so little alloy is present and that the coating is much more uniform in the powder-based product.

Plastic-coated Steel

Efforts have been mainly directed towards evolving a cheap, pore-free coating of P.V.C. on thin strip. To reduce costs it was decided to use P.V.C. powder, since this is the cheapest form of P.V.C. and has the additional advantage of allowing curing of the adhesive and gelling of the plastic in one operation. A very compact high-speed plant (perhaps 500 ft. per min.) was envisaged. Developments in the direct calendering operation have now enabled the experimental plant to be operated at its full speed of 30 ft. per min., and steps are now being taken to increase the maximum speed.

PLANT ENGINEERING AND ENERGY DIVISION

Rolling-Mill Plant

Finishing Processes

It is considered that too little attention has been paid in the past to the handling and treatment of rolled products once they leave the mills. A start has therefore been made on the study of problems arising in the handling of large outputs from the saw bench to despatch. Time studies covering the operation of cranes, flow through the cooling banks, and various finishing processes, and studies of the routes have been carried out in a member's works.

Stress Level Recorder

Following the successive breakage of two palm end couplings on a blooming mill of a member firm, measurements of torque in the spindles were made. No overloads were observed during the tests, but because of the character of the breakages it was suspected that high overloads must occur under certain circumstances and that it would therefore be desirable to record loads over a long period. Since the continuous use of a fast-response chart recorder for an indefinite period was not possible it was decided to develop an instrument to register and count automatically when stresses exceed preset levels.

The prototype instrument has been made as a transistorized unit which can be left unattended for long periods. Because of the difficulty of taking reliable continuous readings from strain gauges mounted on a rotating shaft, the instrument has, in the first instance, been set up to record strain-gauge signals from both sides of the mill housing; these are fed to the level detector operating at two levels to bracket overloads within a certain range. The prototype level detector has been installed on a

production mill and its display unit gives the mill manager up-to-date information on any abnormal stresses in the housings. This system of recording unusually high loadings occurring infrequently could have a side application.

The measurement of stresses in mill shafts has focused attention on the difficulty of obtaining information from inaccessible parts of steelworks plant, and a start has been made on developing more satisfactory equipment for this purpose. At present special slip rings are in use and these are being improved, but it is hoped ultimately to use telemetering and thus make all measurements completely independent of sliding contacts.

Primary Mill Automation

To ascertain the accuracy of operation and the speed attained with remote position control, a 50-h.p. motor is being used to simulate the screw-down on a rolling mill, and a pulse generator coupled to it gives 200 pulses per effective inch of screwdown. The pulses are fed to a two-way counter so that the number standing on the counter gives an accurate measure of the absolute position of the motor shaft, and the time taken to achieve each screwdown setting is recorded.

This equipment has been used in comparative tests on automatic and manual working on a position control drive. For manual working a highly skilled rolling-mill operator from a prominent steelworks has operated the manual control for a duration of one shift, working through a series of pre-determined rolling programmes. For the automatic operation, a comparatively unskilled member of the laboratory staff has used the translator and the " next pass " button procedure to run through the same programmes.

The results are being analyzed on the BISRA Pegasus computer and the complete assessment is awaited, but preliminary calculations show that although the speeds of the two modes of operation were approximately the same, the accuracy attained under automatic working was significantly better. This equipment can be used to compare the accuracies of manual control and automatic control on production mills.

The prototype position control equipment installed by BISRA on the primary mill of a large steelworks has been commissioned and over 1,000 tons of steel have been rolled with it. A comprehensive report dealing with the theoretical and practical aspects of remote position control of screwdown has been issued. Since several large electrical manufacturers have either successfully installed closed-loop controls on rolling mill screwdown or are willing to do so, further work on screwdown control is not called for from BISRA.

Annealing Pilot Plant Control

The pilot plant for continuous annealing, recently installed at the Association's South Wales laboratories, has been equipped with automatic controls. The plant consists of four units : uncoiler, process tension bridle, speed control bridle and coiler.

There are facilities for inching each unit in turn in order to thread strip. Strip tension up to 300 lb. is continuously controllable within the fine limits necessary for the annealing project, and strip speed up to 600 ft. per min. with preset acceleration and deceleration rates can also be controlled with the necessary precision. This original control scheme was designed by the Mechanical Working Division and A.E.I. in collaboration, and was commissioned by members of the Electrical Engineering Section.

CHEMISTRY DEPARTMENT

Corrosion

The properties of rust have an important influence on the corrosion process. The study of these properties has continued with the exposure outdoors of many steel panels. The exposure schedule will provide rust samples 2 to 12 months old produced at different seasons of the year. The samples will be investigated in detail, with particular attention to trace contaminants and inhomogeneity. These natural rusts will be compared with rusts produced under controlled conditions in an apparatus being developed to give a continuous flow of purified air of known humidity and sulphur-dioxide content. These experiments will show how rust properties vary with conditions of formation.

To study the inhibiting effect of sodium silicate on corrosion in water the slow rotor apparatus (described in the 1958 Annual Report) has been used. Mild-steel rods were rotated in pure water and in aqueous solutions with sodium silicate at various concentrations and one of the following at constant concentration : calcium, sodium or magnesium sulphates or chlorides, sulphuric or hydrochloric acid. Further work in this field will depend on the analysis, now being carried out, of the experimental results.

Exposure trials of paint on metal coatings have continued and further work is being organized as a co-operative research through the Corrosion Advice Bureau. A literature survey has been made of methods of protecting steel in confined spaces in ships, particularly those which have to carry fuel and sea-water ballast alternately.

PHYSICS DEPARTMENT

Instruments Section

The work of the Instruments Section during 1960 was mainly concerned with the development of new or improved instruments of in-line inspection of quality, surface finish and dimensions of rolled products. In many instances subjective visual inspection of the moving material, or of the static material off-line, are still the only established techniques. The progress of automation, however,

demands inspection devices which can be integrated with high-speed continuous flow lines to control automatic sorting or grading of the product.

Continuous Inspection of Steel Sheet for Lamination

Ultrasonic techniques have been successfully used in the past to detect lamination in stationary sheets, and an instrument is manufactured on the continent for inspecting moving sheets on a conveyor. This, however, requires the sheets to be fed broadside, *i.e.* in a direction perpendicular to the direction of rolling, and is unsuitable for inclusion in a continuous line, where the sheets move parallel to the direction of rolling.

A suitable method has therefore been developed, in collaboration with Kelvin and Hughes Ltd., for the continuous inspection of strip and grading of sheets after the shears, or at other appropriate points along the line; it needs only one twin probe to inspect the full width of the strip. The twin probe, containing transmitter and receiver in one unit, is located near one longitudinal edge of the sheet. The transmitter fires ultrasonic pulses across the width of the sheet, and echoes from lamination defects and from the far edge are received by the detector. The amplified echo signals are displayed on a cathode-ray-tube monitor and can be used to trigger a reject gate whenever the signal amplitude exceeds a preset limit. Acoustic coupling between probe and steel surface is through a film of oil. When inspecting discrete sheets the probe is automatically lowered on to the front and raised when the tail arrives.

Trials of the equipment have been carried out on a sheet inspection line at a member's works and good results obtained at a line speed of 80 ft. per min. Comparisons between defects shown by the instrument and laminations in the sectioned sheet observed under the microscope show good agreement. The equipment is being developed now for use at line speeds up to at least 300 ft. per min.

Continuous Surface Finish Inspection of Tinplate

At high line-speed an inspector cannot observe and assess reliably surface defects on moving strip or sheets with the unaided eye. Thus when tinplate is to be despatched in coils an instrument will be required to assess the quality of each coil and give a record of the type and number of defects in it. While tinplate is supplied in sheets such an instrument would be advantageous compared with present visual practice.

Work has proceeded on two lines of development of instrumental aids to inspection. The first consists of a multichannel photoelectric instrument which will actuate a sheet-sorting gate or produce a record of faults in a coil. A 10-channel experimental instrument, to inspect 1 ft. width of the tinplate was completed. It includes a strip light source to provide illumination normal to the surface, and photocells arranged to receive only off-specular diffusely reflected or scattered light from the tinplate surface. Separate amplifiers are now attached to each photocell and the instrument has been tested at the Battersea laboratories using a belt conveyor to carry tinplate sheets under the inspection head. Sheets with typical surface defects were fed to the conveyor and a multichannel high speed recorder used to record the photocell signals. The sensitivity and consistency of the instrument were most encouraging. The photocell signals are shaped and summated to obtain an output which could be used to actuate a sheet reject gate whenever a preset level is exceeded.

Trials of the apparatus are proceeding at a member's works to obtain recordings of the signals due to all usual surface defects and thence to correlate the magnitude and character of the photoelectric signals with the inspector's assessment of the severity of the defects. The present equipment is arranged to deal with bright tinplate, and means of extending its use for matt steel strip surfaces are being investigated.

The second line of approach is the development of a visual aid to inspection by providing an optical system of image arresting and closed-circuit T.V. for viewing the stopped section of moving strip. An apparatus has been set up consisting of a system of illumination and a T.V. camera so arranged that only light scattered from the tinplate surface at a well-defined angle off-specular reaches the camera. This has shown that although the camera is mounted some 12 ft. above the tinplate sheet small surface defects show up clearly on the T.V. monitor on a dark background.

A synchronized oscillating-mirror type device called a web viewer is now commercially available in this country for arresting the image of repetitive (*e.g.* printed) patterns on moving web. This is being further developed in the Section for inclusion in the inspection system in the following way. The television camera is attached to the web viewer so that it receives scattered light from short length of strip situated centrally in the field of viewing. The motion of the mirror causes successive short lengths of strip to cover the full area of the camera frame. A stationary image of full width, and several feet length of strip, can thus be displayed on the television monitor. By using an afterglow tube the images can be retained on the tube long enough to give the inspector time to register a defect. Methods of obtaining a compact recording for subsequent evaluation and assessment of coil quality are being considered.

Strip-speed Meter for Temper-mill Control

A novel technique of non-contact strip-speed measurement has been developed in the Section. It was originally suggested in the middle of 1959 as a method suitable for accurate comparison of ingoing and outgoing strip speeds in a temper mill;

the percentage extension measured in this way is equal to the thickness reduction in the mill. The basis of the method is that the strip surface is illuminated with two spots of light (images of lamp filaments) arranged approx. 15 in. apart and in line with the direction of motion of the strip. Two photocells are arranged to view separately the light reflected from the surface at these spots. As the strip passes, variations in its surface cause variations in the reflected light intensity and, since the same portion of surface passes the two filament images in turn, the light signals received by the two photocells are the same, apart from a delay in time. The earlier signal is delayed on a tape recorder, the two signals are then correlated and the delay is adjusted until the correlation is a maximum. The strip speed is then known from the delay and the distance between the images.

The laboratory apparatus has been developed so that the tape-recorder delay, which is adjusted by moving a pick-off head, follows the correlation peak automatically. By simulating moving strip with a gramophone turntable a resolving power of at least 1/5,000 is achieved when the strip speed is 450 ft. per min.

For trials, an experimental apparatus has recently been fitted to the output side of a temper mill. The mill trials have shown that even with the strip flapping over a range of approximately 1 in. the level of signal correlation is only marginally less than that measured in the laboratory and a resolving power of the same order is observed.

Patents have been applied for and a licence to manufacture speed meters based on this principle has been taken out by Davy and United Engineering Co. Ltd. As well as its use for temper elongation measurement, an early application envisaged is for measurement of strip speed in a tandem hot-strip mill, thereby monitoring continuously the thickness reductions through the mill. Considerable interest has been shown in possible uses of this device in other industries. Details of the laboratory instrument are to be published in the " Transactions of the Society of Instrument Technology."

Tandem-mill Control

A set of experiments to determine the coefficients in the linearized perturbation equations has been carried out with the co-operation of a member firm on their 4-stand mill. The instrumentation was more complete than in the preliminary experiments mentioned in the Annual Report for 1959. Flying micrometers were fitted after the second and third stands, and these, together with the thickness measurement devices in regular use after the first and fourth stands and the existing inter-stand tension, roll-force and roll-speed gauges, completed a comprehensive system of instrumentation. Several coils of approximately equal width but rolled to a range of schedules and speeds were used. During the rolling of each coil small step changes were made to the stand screw and speed controls and all the measured mill variables were recorded. These records have now been analyzed and the coefficients deduced, using regression analysis. Significances of order 0.1 per cent are observed in many cases. The coefficients obtained will be used for simulation on the general purpose analogue computer which was purchased towards the end of 1960. This computer will be useful for a wide range of problems but is initially being set up to simulate the production mill studied, using the coefficients now available, with a view to designing the most suitable form of automatic gauge control system for that mill.

FLUID DYNAMICS SECTION

Fluid Cushioning

In complex strip-processing lines, such as electrolytic tinning lines, large numbers of guide rolls have to be employed. With the trend to thinner-gauge strip, the design of guide rolls and speed controls for drive motors becomes more difficult and costly if strip breakages are to be avoided. It seems desirable, therefore, to find an alternative method for guiding and conveying strip.

Calculations and laboratory experiments indicate that gas cushioning is technically feasible and economic for the support of light gauge strip passing through a processing line. The conventional assemblies of rollers would be replaced by a series of guide surfaces with a cushion of gas between them and the moving strip. The cushion is formed by injecting, *via* suitable nozzles, a quantity of low-pressure gas between the strip and the guide surface. The resulting great reduction in friction losses and the elimination of rolls with high moments of inertia means that less power will be required to move the strip, especially during speed changes; also, the strip need not be under high tension to preserve correct track and its surfaces would not be marked by contact with rolls. Gas cushioning systems offer possibilities of novel forms of plant design, leading to a more compact processing plant, and consequent reduction in capital costs.

A system has been designed which allows for gross irregularities (such as lap weld) in the strip, and experiments to determine the most suitable means of forming a gas cushion have now been completed. An apparatus has been built in which strip moving at speeds of up to 1,000 ft. per min. can be passed round a 180 deg. arc over a semi-cylindrical gas cushioned bearing. This is for study of the effects of strip speed and acceleration on bearing performance.

A novel form of " looping tower " employing gas cushioning has been designed, and an experimental version will shortly be built to demonstrate the feasibility and merits of the principle in this application.

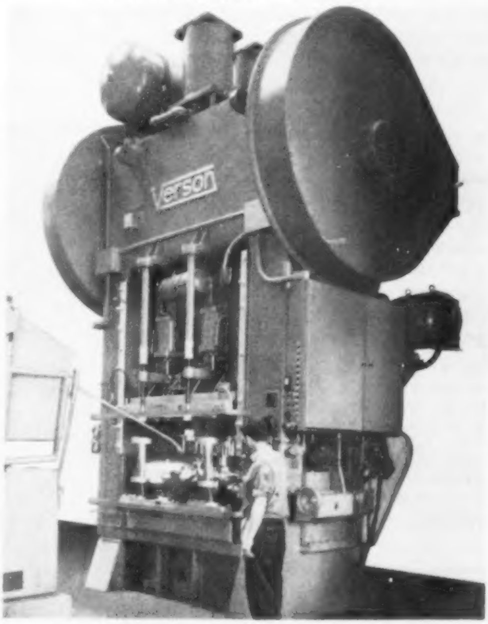
PRESSURE ECONOMY

By MELVIN D. VERSON *

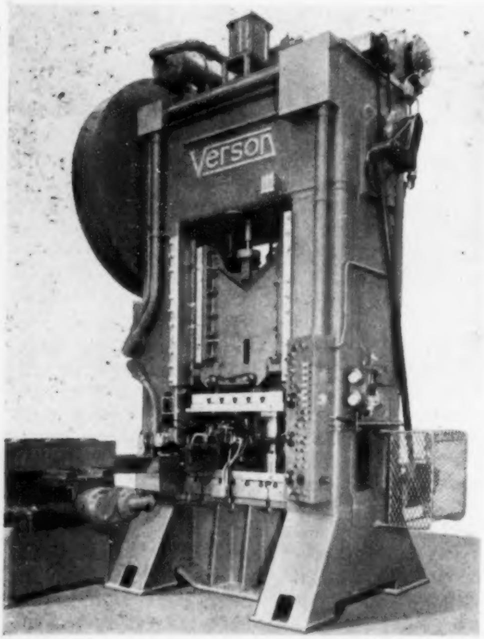
(A paper presented at the Special Conference on "The Cold Extrusion of Steel", organized by the Institute of Sheet Metal Engineering, Sheffield, November, 1960)

THE subject of this paper is "Impact Machining" and this terminology means cold extrusion basically carried to the point of eliminating finished machining. This is not always possible but represents an effort to applying the principles of cold extrusion to the point where there is little or no machining necessary after extrusion. The economies of this effort are quite apparent since the achievement of these aims results in a substantial reduction of raw material to accomplish the same piece-part configuration as well as the reduction of machining operations required by other methods. Cold extrusion is a displacement of ferrous or non-ferrous material in a plastic manner similar to squeezing a piece of clay between one's fingers and displacing it at random to no geometrical proportion. In ferrous and non-ferrous materials the material can be displaced plastically to form a part of exact geometrical specifications. The part is confined in a die and displaced by a punch or punches to a final piece-part such as a cylinder. That is cold extrusion. The material is put in cold, worked cold and produces the desired final piece-part. Throughout the years, extrusion principles have been applied to various materials such as aluminium, brasses, copper and in recent years to many other materials. However, this does not seem to carry the strangeness that cold extrusion of steel implies to the uninitiated. The fact that steel is extruded by using steel tooling appears on the face of it to be rather strange. Low-carbon steels that have a yield point around 37,000 lb. to 40,000 lb. per sq. in. are worked with applicable tooling. Basically, the first reason that this can be accomplished is that an efficient lubricant is used. Without this there can be no cold extrusion of any practical value as lubrication prevents the tooling from galling and seizing and being destroyed by the surface friction that would be generated between the work-piece and the tooling itself. The lubricant acts as a barrier and provides a low frictional value during the displacement of material by the extrusion tooling. To do this the lubrication must be able to stand unit pressures of 180,000 lb. per sq. in. up to and including 400,000 lb. per sq. in. The usual lubricants such as viscous mineral oils, waxes, etc., that depend on surface tension strength to lubricate are not sufficient for this type of work and will not withstand the high pressures to accomplish economically successful cold extrusion. A suitable lubrication system to use in cold extrusion consists basically of a zinc phosphate crystalline deposit bonded chemically with the base material by an intermetallic bond created during the deposition of the zinc phosphate. The crystalline deposit is subsequently impregnated and coated with a zinc stearate soap. At present there does not appear to be another system that will produce comparable results. This system of lubrication is

Fig. 1.—Verson steel, double-crank, single-action, single-gear, twin-drive, impact-machining press



* President, Verson Allsteel Press Co., Chicago, Illinois, U.S.A.



somewhat similar to that used in a pre-paint treatment in which the phosphate would range in weight from 90 to 120 milligrams per square foot. However, a zinc phosphate for cold extrusion would range from a minimum of 800 milligrams per square foot to 3,200 milligrams per square foot for severe applications. Thus the zinc phosphate for cold extrusion must react very efficiently with base material to exist in the environment of the high pressures required for the cold extrusion. In addition to a good lubrication system there are other factors that must also be reckoned with. Referring back to unit pressures mentioned earlier which range from 180,000 to 400,000 lb. per sq. in. it can be seen that the tooling application is a critical one. The tools must have the strength to withstand these high unit pressures and the application of the tooling must be guided quite closely both for dimensional reasons and also for good tool life. The tool steels used in such an application would consist of either an AISI M2, M3 or M4 type of tool steel. The English equivalent of the AISI M3 tool steel would be the "Mushet Special" High Speed Steel VG produced by Samuel Osborn's, M3 made by Canadian Atlas, J. Edgar Allen (Attor M3), Jessop-Saville J13. These among others have a chemical analysis similar to the AISI M3 and would seem to have properties suitable for cold extrusion of steel. Characteristics of these steels are illustrated in chart form in Tables I to VI. On certain applications where high wear resistance is required due to an unfavourable configuration of the part to be extruded would be used a tool steel of the high-carbon, high-chrome type. The AISI M3 tool steel properly heat treated would have a yield point in excess of 480,000 lb. per sq. in. and a hardness of Rockwell C65 to 67. This has been the practice at Verson and has been established as a successful one. The M3 type of tool steel is used quite prevalently for both the extrude punch, die, and anvil punch because of its very excellent high yield strength and its red hardness which is sufficient for most applications. If a degree of toughness beyond that of the

Fig. 2 (above).—Verson steel single-eccentric-shaft, single-action, single-gear, single-drive press

Fig. 3 (right).—Photograph illustrating guide pins and bushings that guide upper and lower shoes for precise alignment of working tool; guide bushings for final punch alignment; mounting of punches on upper die shoe; dial transfer plate; die assembly and weldment; slug feed mechanism

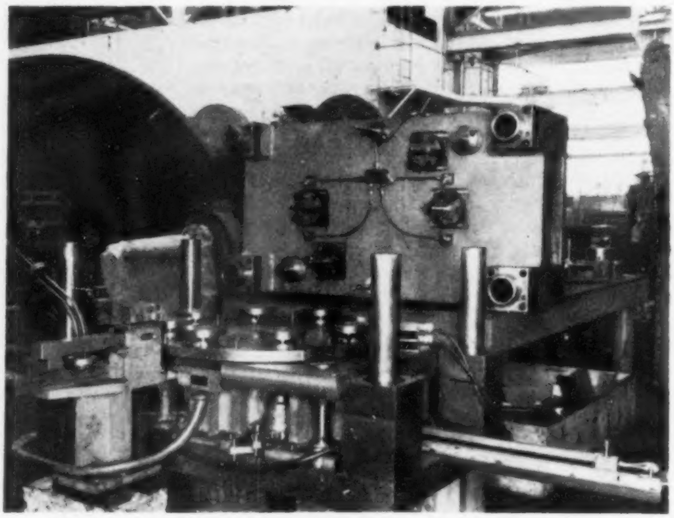
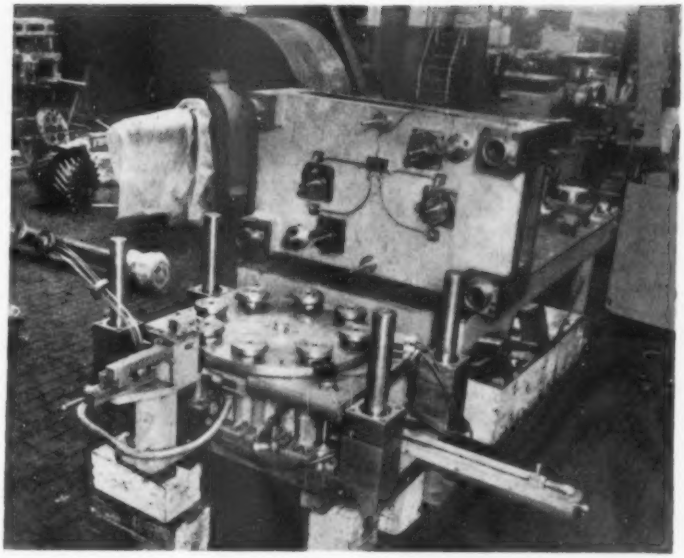


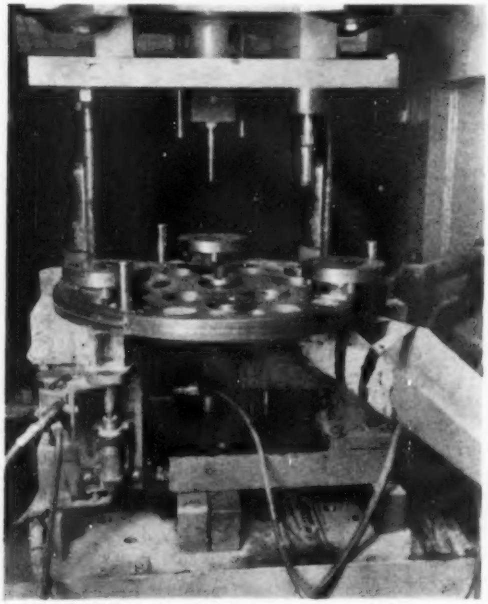
Fig. 4 (right).—Dial table and shuttle feed

Fig. 5 (below).—Stripper guide to guide punch in initial contact of workpiece



M3 steel is desired, then M2 and M4 steels are used.

One of the most important points of tooling for cold extrusion is maintaining good alignment. At these high pressures it is essential to avoid having the punch deflect in the column. It must be guided both by the inherent characteristics of the press and the guiding characteristics of the die stack so



that the punch is not subjected to bending loads which result in early failure. To do this there are special requirements that must be adhered to in the construction of the press itself. It is the author's contention, proved in practice, that the press deflection on the columns during cold extrusion work must be held to a value roughly half that of a standard press design for sheet-metal work. It must be strengthened in a bolster and sub-bolster construction so that the deflection of the structurals are kept to an absolute minimum. The press itself if mechanical, may be of a single-point or double-point suspension design depending on the type of tooling and operations to be included in the tooling. The upper and lower shoes of the tool stack are always guided by guide pins and close-fitting bushings to control the last portion of the ram movement so that the exact alignment of the punch and die and work-piece can be maintained.

The tooling itself produces several types of basic cold extrusions and these may be produced singly or in combination for the manufacture of the piece-part desired. Basically they may be divided up into the following classifications : (1) Backward extrusion in which the plastic flow of the material is in opposition to the movement of the punch. In other words, the material moves in the opposite direction to the travel of the punch. (2) Forward extrusion in which the material flow is in the same direction as the punch movement. (3) Coining so that exact configurations can be maintained or altered to suit. (4) Drawing, which would be a conventional operation where the punch is pulling the material through a die and many of the other

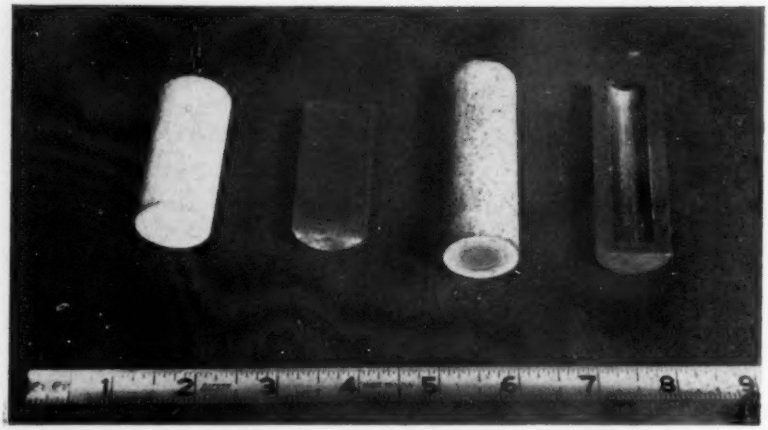


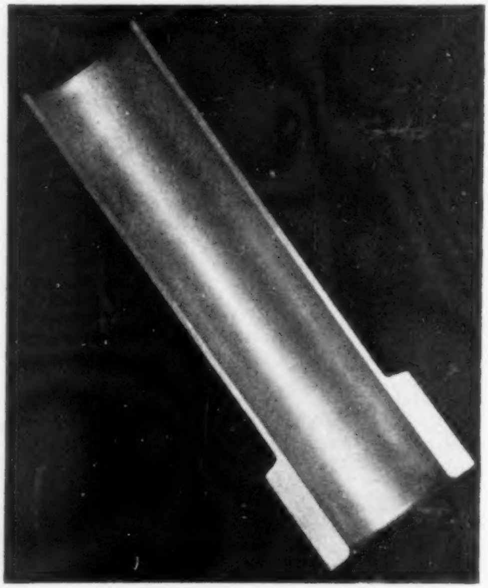
Fig. 6 (left).—Slug and part produced by backward extrusion operation

Fig. 7 (below).—Forward extrusion operation

conventional metalworking terminologies that would apply to a series of operations in achieving a final piece-part dimension.

The ferrous material that can be extruded in practical tooling applications would include the very low-carbon steels in the order of 0.08 to 0.10 per cent carbon ranging up to and including a 0.30 per cent carbon steel, which are commonly termed plain low-carbon to medium-carbon steel. However, there are certain alloying constituents that must be observed so that the extrusion pressures do not exceed the practical limit of cold extrusion. Among these alloying constituents is silicon, which should be kept to a low value. In American practice the silicon can range from a minimal value to as much as 0.30 per cent Si. In the low-carbon steel range it has been practice to hold a silicon value of 0.15 to 0.20 per cent in a fully aluminum-killed steel. Also the manganese should be held between 0.60 and 0.80 per cent where the carbon is on the high side. However, the very low-carbon steels in the order of 0.10 to 0.12 per cent carbon have been used with manganese contents up to and including 1.35 per cent Mn. With this high manganese percentage in 0.20 to 0.30 per cent carbon steels, the rate of cold working becomes so rapid that extrusion pressures are apt to be extremely high and the life of the tooling consequently to be shorter than with a low-carbon steel with less manganese and less silicon.

Steel of the carburizing variety and a steel with 0.15 to 0.20 per cent carbon have been used successfully. This includes the 5100 series, the 4600 series, 8600 series and in a few cases the 5000 series. There are certain matters to be considered in this range of carbon with these alloy steels. As the nickel content is raised the initial extrusion pressures will be increased. The carbide formers in the usual ranges do not raise the initial pressures so rapidly as in the 5100 series and the 8600 series. The chromium in the 5100 series and the Cr.-Ni.-Mo. in the 8600 series, cause a slight increase in the extrusion pressure but these steels can be very successfully extruded. Starting hardnesses will range from Rockwell B70 to as much as Rockwell B85. The 4600 series presents a little tougher application for cold extrusion in that the higher nickel content reduces the chances of success with a minimum value in hardness and in strength. Nickel being a ferrite hardener does not respond to thermal treatment such as annealing for the soft extrudable structure desired. So it is seen that in the 4600 series a steel is being dealt with in which the minimum hardness on a straight anneal would be Rockwell B80 to 85 and the characteristics of rapid



work hardening. This steel is being used in various instances for the extrusion of roller-bearing races and other similar applications where the real tough core for carburizing is desired.

Alloy steels of the hardenable variety with which the author has had success would be of the AISI 4130 and the AISI 94B30 which is a boron type of steel with 0.30 per cent carbon. These can be extruded but are at present limited to a 50 to 55 per cent reduction of area which can be accomplished with good tool life. Tool life must be expected to be somewhat more limited above the 0.30 per cent carbon steels, alloyed or unalloyed. The 0.35 per cent carbon to 0.40 per cent carbon presents such high starting pressures that the impact resistance of the tooling is reflected in the lower endurance limit and more rapid fatiguing. This has been proved at Verson's to be impractical for economical high-production cold extrusion. There are exceptions for special cases where the grain refinement and the enhanced physical properties are desirable and economical for those reasons alone.

Besides producing the geometrical form in cold extrusion there are other advantages in the straight carbon material in that the cold working will improve the physical properties quite markedly and has been utilized on some applications to achieve the final physical properties desired in the piece part. For a low-carbon steel with a yield point of 35,000 to 38,000 lb. per sq. in. and ultimate strength in the order of 50,000 to 55,000 lb. per sq. in. and elongation value of 25 to 35 per cent cold working achieves an improvement in physical properties, *i.e.*, an ultimate strength of 91,000 to 96,000 lb. per sq. in., a yield point of 84,000 to 87,000 lb. per sq. in. and elongation value of 10 to 12 per cent and a final hardness commensurate with these physical properties of Rockwell B95 to Rockwell B105. It is easily seen that this is a tremendous increase in physical properties and can be utilized as such in many applications for structural members. However, in most instances, in the manufacturing groups utilizing cold extrusion, the carburizing variety of steel, either plain carbon or an alloyed medium-carbon steel, has been employed to produce a piece-part configuration that is subsequently carburized and hardened for wearability and the desired physical properties.

Presses used for cold extrusion must be designed for the work and may be of several varieties, each having their own advantages. A mechanical press can be used either of a crank type or eccentric type ; in some cases a knuckle-joint press may be used for short high-pressure strokes or it is possible to use a hydraulic press. The author has no individual preference as Verson manufacture all these types of presses. The crank-type mechanical press has been widely used for the reasons that it lends itself to high-speed production and adaption of automated equipment both in the feeding of the material to the press and the transfer of the material or slug from one station to the other until all operations have been performed. On longer pressure strokes an eccentric press design would be used because of its advantages for alignment in the stroke of the ram and the structural reasons as compared with a crank type. This also lends itself quite readily to automated procedures like the mechanical crank type. If the production requirement or the productivity of equipment does not have to be high, a hydraulic press should be considered because the pressure stroke is long and the expensive drive of a mechanical press would not be necessary and in such conditions the hydraulic press may have advantages from the point of view of economics.

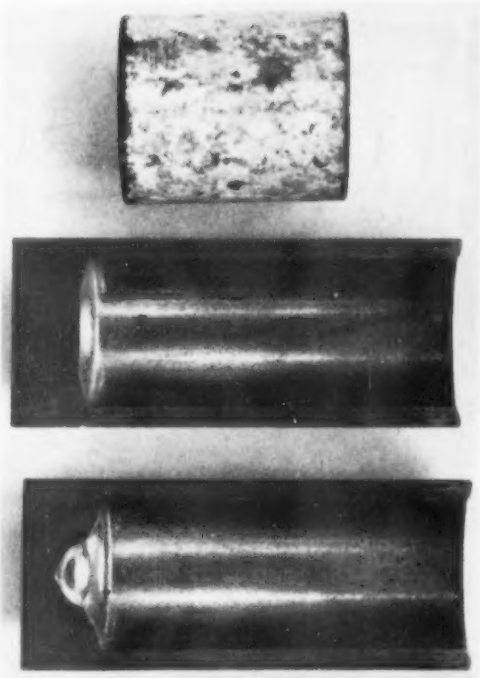


Fig. 8.—*A backward extrusion with a final coin operation on base of component part*

From the above statements it is readily seen that all of the available types of presses can be used for cold extrusion and the main point in selecting a press is the type of cold extrusion work to be done. We maintain that where there are no special requirements as to long pressure strokes, the crank- or the eccentric-type mechanical press would be the proper selection for universal use.

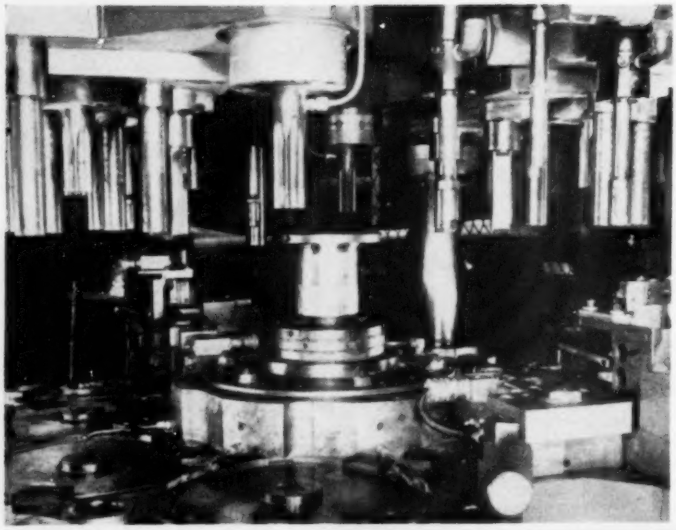


Fig. 9 (*left*).—*Overall view of impact machining tooling mounted in the Verson rotary dial feed*

Fig. 10 (*below*).—*Effect of deep seam where O.D. surface is put into tension by a heading operation*

One of the most important aspects of cold extrusion is the procurement of the slug for the extrusion itself. The basic materials in the relationship to extrusion have been mentioned and it is now necessary to consider cutting-off the slug into the proper diameter length and volume so that the extrusion will have the proper dimensions as required. The stock for the slug may be furnished from the mill in bar or coiled wire form. In general, the mill should furnish the material to meet cold heading quality specifications. This defines the surface quality to be free of seams, laps and detrimental subsurface inclusions. A steel meeting these requirements in most cases will be quite satisfactory for extrusion. The chemical analysis held within the AISI specification tolerances will be sufficient and not cause undue variations in plastic flow properties. Internal defects should be held within the limits applied to good hot-forging or cold-heading practice. Marked centre porosity, piping and severe chemical segregation cause difficulties in cold extruding and should be checked in the course of acceptance of shipment from the mill. In the range of low-carbon steel with the carbon content up to 0.20 per cent carbon, it has been found that a lamellar perlitic structure upon annealing is sufficient. This gives the best plastic properties commensurate with cost. A spherodized structure can be produced and used but the gain in better flow properties is not worth increased cost for the annealing procedures involved. Control of the diameter of the bar or wire is influenced by the degree of volume preciseness required in the extrude operation. It is directly controlled by the character of the shear fracture where shearing is employed. Where shearing is used as a cutoff means, the preference is to use the cold draw or cold finish diameter tolerances, plus or minus 0.002 in. This allows the shear die to be made with minimum clearances for the bar and prevents excessive distortion in the cutoff and produces a cleaner breakoff for shear surface. Bar can also be cut off by screw machines or saws. It is important to realize that the surface produced by any of the methods must be good and clean ; torn

surfaces, burrs, deep tool marks and other excessive surface irregularities must be avoided. Such irregularities can, during extrusion, fold and be carried in the extrusion flow as a non-integral portion of the I.D. or the O.D. surface, producing an undesirable defect and because of their character cause a breakdown of the lube surface with consequent galling and seizing of the punch and die. When the slugs have been produced by machining or sawing, the O.D. may be to die size and used directly for extrusion after lube coating. If shearing has been employed the slugs should be headed to the proper O.D. and the ends squared. Heading of slugs prior to the extrusion operation is not confined to sheared slugs alone. This may be applied with advantage to other types of cutoff methods. If hot-rolled stock is used, heading will bring the O.D. to proper size in tolerance for the extrude die.

After heading is employed the cold work developed must be relieved by annealing. This will recover the ductility lost by the operation and reduce the hardness and the co-related starting pressures. The anneal may be of two types, one a high temperature anneal to recover the cold work and produce a lamellar pearlite structure or two, a low temperature anneal at 1275 to 1325° F. (690 to 722° C.) for a recrystallization recovery anneal.

The following Tables give details of the various type tool steels used for extrusion :

TABLE I—*AISI Type M-2—Punch and Die*

Carbon	0.80/0.85 per cent
Silicon	0.20/0.30 ,, ,,
Manganese	0.20/0.30 ,, ,,
Sulphur	0.025 ,, ,, max.
Phosphorous	0.025 ,, ,, max.
Tungsten	6.00/6.75 ,, ,,
Chromium	3.90/4.40 ,, ,,
Vanadium	1.75/2.05 ,, ,,
Molybdenum	4.75/5.25 ,, ,,
Temperature for forging	2050/1700° F.
,, ,, annealing	1550/1600° F.
,, ,, pre-heating	1400/1500° F.
,, ,, hardening	2180/2250° F.
,, ,, tempering	1000/1150° F.

Generally is austenetized at 2200° F. and tempered at 1050/1100° F. for maximum toughness at Rc 62/64.

TABLE II—*AISI Type M-3—Punch and Die*

Carbon	1.20 per cent
Tungsten	6.00 ,, ,,
Chromium	4.10 ,, ,,
Vanadium	3.20 ,, ,,
Molybdenum	6.00 ,, ,,

Other elements as specified in M-2 Type.

Temperature for forging	2050/2080° F.
,, ,, annealing	1550/1600° F.
,, ,, pre-heating	1450/1550° F.
,, ,, hardening	2200/2250° F.
,, ,, tempering	1000/1100° F.

Practice is to quench from 2175/2200° F. in oil and draw at 1050° F. for maximum hardness of Rc 65/67.

TABLE III—*AISI Type M-4—Punch and Die*

Carbon	1.27 per cent
Tungsten	5.50 ,, ,,
Chromium	4.50 ,, ,,
Vanadium	4.00 ,, ,,
Molybdenum	4.50 ,, ,,

Other elements as specified in M-2 Type.

Temperature for forging	2050/1700° F.
,, ,, annealing	1600° F.
,, ,, preheating	1400/1500° F.
,, ,, hardening	2175/2250° F.
,, ,, tempering	900/1200° F.

Practice is to quench from 2200° F. in oil and draw at 1050° F. for a hardness of Rc 64/65.

TABLE IV—*AISI Type D-7—Punches*

High Carbon—High Chromium

Carbon	2.30 per cent
Chromium	12.50 ,, ,,
Vanadium	4.00 ,, ,,
Molybdenum	1.10 ,, ,,

Other elements as specified in M-2 Type.

Temperature for forging	2050/2100° F.
,, ,, annealing	1600/1650° F.
,, ,, pre-heating	1400/1450° F.
,, ,, hardening	1900/2000° F.
,, ,, tempering	350/400° F.

Practice is to quench from 1900° F. in air and draw at 375° F. for a hardness of Rc 62/64.

TABLE V—*AISI Type H-12—Shrink Rings*

Carbon	0.35 per cent
Silicon	1.00 ,, ,,
Chromium	5.00 ,, ,,
Tungsten	1.20 ,, ,,
Vanadium	0.35 ,, ,,
Molybdenum	1.45 ,, ,,

Temperature for forging	1600/1950° F.
,, ,, annealing	1650° F.
,, ,, pre-heating	1200° F.
,, ,, hardening	1825/1850° F.
,, ,, tempering	1000/1200° F.

Practice is to quench from 1850° F. in air and draw at 1050° F. for a hardness of Rc 48/52.

TABLE VI—*Comparable Grades to AISI M-3 Tool Steel*

Samuel Osborn & Co. Ltd., Clyde Steel Works, Sheffield. "Mushet Special" High Speed Steel VG.

Carbon	1.55 per cent
Tungsten	6.5 ,,
Chromium	4.75 ,,
Vanadium	5.0 ,,
Molybdenum	3.0 ,,
Cobalt	5.0 ,,
Forging:	Pre-heat to 750/800° C. Raise to 1,100/1,120° C. Do not forge below 900° C. and finally slow cool.
Annealing:	Heat slowly and evenly to 850/900° C. Cool in a furnace.
Hardening:	Pre-heat to 800/850° C. Harden at 1,200/1,220° C. from a controlled atmosphere furnace or neutral salt bath. Quench in Oil, Air, or Salt Bath at 540/580° C.
Tempering:	Three periods of 1 hour minimum at 540° C.
Hardness:	Rockwell C 66/68.

Canadian Atlas M-3 type steel.

Edgar Allen, Sheffield. M-3 type.

The practice on all the high speed steels has been to triple draw. This gives maximum structure stability and reduces retained austenite to a minimum. It is also good practice to double draw the D-7 and H-12 steels for the same reasons.

DISCUSSION

Mr. MORGAN (R.O.F., Birtley) said that several years ago he had successfully pancaked a piece of bar stock. In fact, he had felt that this was a new discovery and had passed the information on to a NATO Sub-committee as something that other people should use as well. The American representatives had reported during the following year that they had tried it without success, and had not believed that it could be done. Possibly, in the Frankfurt Arsenal the Americans had had bad steel. R.O.F. had this as well, of course, sometimes, and he was wondering about the possibility of carrying out the operation really successfully at the moment. R.O.F. thought that it did the operation quite well because the top and bottom tools were concave and the material therefore under compression all the time and being squeezed out through an orifice. He noted that in one of the Verson operations the reverse took place—that convex tools were used and the material pressed out in order to begin to form the next operation. Had Mr. Granby any information on this aspect?

Mr. GRANBY (who presented the paper for the author) replied that he did not think Verson's had encountered any special problems. They had done it in order to try out something and were quite satisfied that it would work. It could be done with a concave surface and also perfectly flat.

Concentricity in Deep Backward Extrusion

Mr. J. A. CLEAL (Aero Heat Treatments Ltd.) congratulated Verson upon the very deep backward extrusion it was achieving. Could Mr. Granby give some idea of the concentricity being maintained in such deep work?

Mr. CHARLES-EDWARDS (replying on behalf of Mr. Granby) said that in one case they were allowed 0.006 in. with a total length of about 8 in. and a punch diameter of $\frac{3}{4}$ in. but had kept within 0.003 in. concentricity.

Mr. MORGAN asked whether Versons were now advocating the use of carbide punches. If so, how did they make them, how did they fix them into a hole, etc., because R.O.F. would like to do the same.

Mr. GRANBY said that Versons were using more and more especially where the extrusion was severe and the accuracy must be maintained. The tool life made the job economical. Their carbides were bought from established American supplies, but it ought not to be thought easy because a great deal depended on the sintering of the carbide and more than once the supply had varied greatly in quality and had had to be rejected. They fixed the punch in a toolholder like an ordinary punch, without special devices.

Mr. MCKENZIE (N.E.L.) said that in some of the products shown the slugs were somewhat smaller than those usual for cans. He was not thinking of the ones that Mr. Morgan was referring to—where the slug was pancaked. It looked as if the slugs were of about $\frac{3}{4}$ in. diameter and the cans about $1\frac{1}{8}$ or $1\frac{1}{4}$. It was his experience that with a loose slug in the chamber it was not possible to locate accurately—it would not flow evenly and the punch tended to bend. How was the slug located to ensure that the product was concentric and did not bend the punch?

Mr. CHARLES-EDWARDS said that Versons did not, as far as he knew, make any special provision for that.

Mr. MCKENZIE said that the slides showed a can in which the slug O.D. was quite a good deal smaller than that of the can. The author had said that it was done in one stage.

Mr. MORGAN said it appeared as if there was a movable die in the top. A component was fed into it, taken down and centralized in the die. It was held by the guide until struck by the punch. This began to spread it under the guide. It then left the guide and was wide at the point of impact. He thought this was the way it was worked.

Mr. CHARLES-EDWARDS said that normally the slug was made slightly less than the die size. It increased very slightly—only a few thousandths. When the slug met the extrusion die it was almost the right size.

Mr. H. T. HUNNISETT (Cold Precision Forgings (D. and C.) Ltd.) asked whether Mr. Granby could give any idea of Versons' experience with British steels for cold extrusion of the component.

Mr. GRANBY said that usually American bar steel produced a better product than the British steel. It was more uniform and easier to form.

Mr. HUNNISETT said he felt it as well to raise this, lest people should go away with over-optimistic ideas that they could do the same sort of thing with British steels.

Results with British Steel

Mr. GRANBY said that excellent results had been obtained with British steel. It was the tooling which was affected—it was originally designed and developed to cope with American steel and had to be modified. This took time and plenty of material was needed for experimentation, but the end result was very satisfactory.

Mr. M. T. WATKINS asked whether this was also indicative of the performance in multiple drawing or extrusion. His own organization had found that when a can was subjected to a second operation cracking was obtained. He noted that Versons subjected their extrusions to repeated operations without any interstage annealing at all. This he found strange, and certainly not consistent with findings obtained on a very limited scale.

Mr. GRANBY said that the essence of the Verson method was to eliminate the interstage annealing,

(*Continued in page* 514)

POWER PRESSES—

Their Design and Characteristics

By E. HAMILTON, A.M.I.Mech.E.*

One of a series of lectures presented at the Wolverhampton and Staffordshire College of Technology on the theme of " The Technology of Deep Drawing and Pressing.")

THIS lecture will be confined to mechanical power press, and it is proposed to start by looking at the fundamental mechanism, which can be seen in use in the great majority of press shops today. This basic mechanism, which translates rotary into reciprocating motion, is the slider crank and has many engineering applications, apart from power presses (Fig. 1).

With the crankshaft rotating at constant angular velocity, the slide has a variable speed from zero at top dead centre to its maximum, at approximately 90 deg., to zero once more at bottom dead centre.

If the connecting rod were infinitely long, the velocity diagram would be a semi-circle, in practice the length of the connecting-rod distorts the diagram.

The velocity for any point between mid-stroke and B.D.C. can be obtained by laying out to scale the mechanism in question ; if the crank rotates at constant angular velocity, ω radians per second then :

Velocity of Slide $= \omega.A.$ inches per second where "A" is measured in inches.

The value obtained should be sufficiently accurate for most practical calculations.

The Need for a Flywheel

This basic mechanism of course is not useful until it will do work, and both the force and energy required can be considerable. Furthermore, on a large proportion of power presses, the time interval for the operation is small.

These conditions can only, as a rule be met economically by using a flywheel, which will store and deliver energy quickly. In fact the simplest power-press drive mechanism consists of a motor driving a flywheel mounted on the crankshaft of the slider crank.

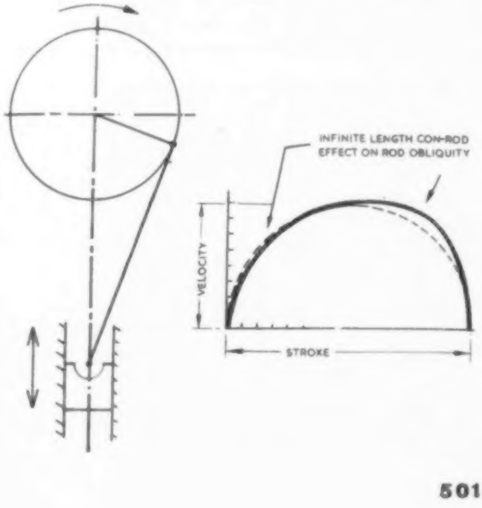
Even this simple press mechanism is incomplete without some means of control, a clutch which provides a means of connecting and disconnecting the source of torque and energy—the flywheel, and a brake which will bring the moving parts to rest after doing work.

This basic mechanism mounted in a frame which provides bearings for the crank and slide and the reaction forces for the work, produces an elementary press, the forerunner of mechanical power presses, large and small.

Variation in Pressure due to Increasing Mechanical Advantage as the Crank Approaches B.D.C.

It will be apparent that the maximum safe torque which the crank will sustain is fixed (*i.e.* the crank is designed to transmit a definite torque), and that the torque reaction from the work is approximately equal to the product of vertical component of the force along the connecting-rod axis and distance "A".

Fig. 1.—Diagram of the slider-crank mechanism showing the semi-circular velocity diagram for a connecting rod of infinite length and the velocity diagram obtained in practice



* Wilkins and Mitchell Ltd.

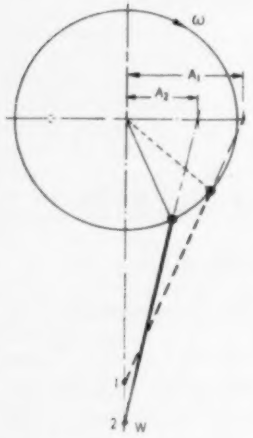
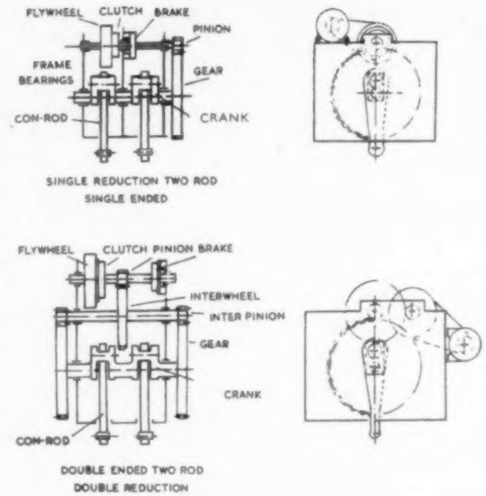


Fig. 2. (left).—Torque reaction from the work is approximately the product of the vertical component of the force along the connecting-rod axis and distance A

Fig. 3 (below).—Properties of the crank showing the increasing force as the crank approaches B.D.C.

Fig. 4 (right).—Types of gear layout



This is equivalent to the force exerted on the work multiplied by "A" (Fig. 2).

Thus it will be seen that as a crank approaches B.D.C. the dimension "A" decreases, so that although the torque exerted by the crank is limited, it is capable of exerting an ever-increasing force as the crank approaches B.D.C.

$$\text{Since Torque} = WA$$

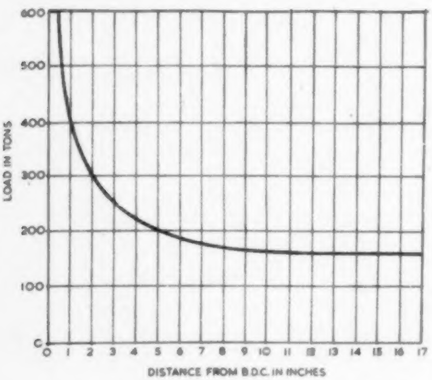
$$\text{and Force } W = \frac{T}{A}$$

This property of the crank is clearly illustrated in Fig. 3.

The Need for Gears

As the stroke of the press increases, or tonnage, or both, the torque requirement at the crank will increase, and in general so will the energy needed.

A stage is soon reached where the clutch and flywheel mounted on the crankshaft will be unwieldy and expensive, except for small presses ; and the press designer has to introduce a gear reduction between the flywheel and crankshaft, thus reducing the torque demanded from the clutch, and size and weight of the flywheel.



Most presses today from 100 tons upwards, are geared in a variety of ways, depending on the type of press, number of connecting rods, speed of operation, and size of press. The greater part are double reduction, particularly in the medium to heavy press range (say 150 to 1,000 tons), but some exceptionally large machines have triple reductions.

There are many varied types of gear layout, which will meet requirements, but the majority today fall into well defined types—some of these are shown in Fig. 4.

It is usual for the first reduction gears to be double helical (Herringbone), since speeds are higher. These gears are also more satisfactory, and less noisy ; sometimes the last reduction gears are double-helical also, and this makes for a very smooth transmission of power into the eccentrics.

Gears

Up to this point the crankshaft has been considered to be one of the important links in the transmission of power in the press mechanism. Most users of the large power presses today, would agree, however, that the crankshaft has been superseded by the eccentric gear, or bull wheel (Fig. 5).

In the eccentric gear the bent crank with its inherent disadvantages, is replaced with a stiff eccentric boss, and this is combined with the final gearwheel in the transmission into one steel casting. The central hub is bushed, and the whole rotates on a fixed forged-steel shaft.

It will be seen from Fig. 5 that this results in an extremely compact unit. The torque is transmitted

directly from the wheel to the rim of the eccentric—the bearings upon which the wheel rotates are close in to the line of thrust from the connecting-rod and the shaft is not subject to torsion.

This type of drive possibly originated in the Black Country. In the late twenties, Walter Samuel Wilkins was building press drives, which were moving towards the full eccentric wheel and in 1933 he was almost there with the double eccentric with a keyed on wheel illustrated (Fig. 6).

By 1935, this design had been fixed, and has remained substantially the same since that date, and was used on a 500-ton, 4-rod, 15-in. stroke press.

It will be seen that not only is the eccentric gear a more compact drive for transmitting power, but its adoption has enabled the whole train of gears to fit more compactly into the modern fabricated frame.

Rating of Presses

As with any other machine, a press must have a rated capacity, and with a power press this falls under two main headings.

(1) Capacity, usually defined in tons.

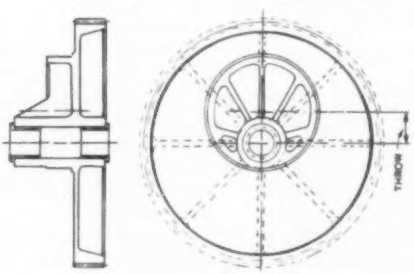
(2) Energy, usually defined in inch-tons.

The tonnage capacity of a press is the rated force in tons the press will exert, but the simple statement "a 400-ton press" is not enough.

It has been shown that the mechanical advantage increases as the press approaches bottom dead centre and thus is capable of exerting much more force near the bottom than say at mid-stroke, so that for, say, a "400-ton press" it is necessary to state at what point in the stroke the rated tonnage can be delivered.

Most press manufacturers here and in America, rate their machines ½ in. before bottom dead centre and this figure has been arrived at as a practical compromise over the years, and seems to fulfil the requirements of most press shops for the general run of components.

Fig. 5.—The eccentric gear or bull wheel



FULL ECCENTRIC DRIVE GEAR

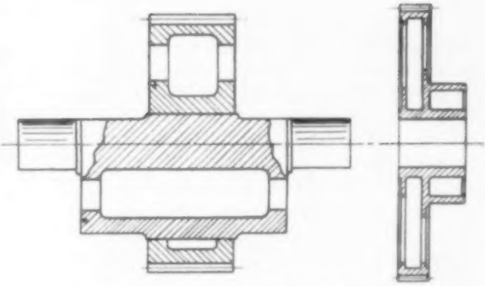


Fig. 6.—The double eccentric with a keyed-on wheel designed by Walter Samuel Wilkins in 1933

It is always possible of course, to fit a drive into a frame that will deliver the rated tonnage higher up the stroke, indeed this has to be done if the work envisaged demands it, but this is more expensive, and the cost must be set against the economic advantages gained.

Table I shows the standards laid down by the American Joint Industry Conference on Punch Press Standardization for the point above B.D.C. for rated tonnage.

TABLE I—*American Joint Industry Conference on Punch Press Standards. Distance from bottom of stroke for rated capacity*

Open-back Inclinable Presses		
Tonnage	Non-Geared	Geared
22	1/32	1/8
32	1/32	1/8
45	1/16	1/4
60	1/16	1/4
75	1/16	1/4
110	1/16	1/4
150	—	1/4
200	—	1/4

Single-action Single and Multi-Point	
	Presses
Single-end geared	¼ in. from btm.
Twin-end geared	½ in. from btm.
Eccentric	½ in. from btm.

Double-action Single and Multi-Point	
Inner Slide	½ in. from btm.
Blank Holder	½ in. from btm.

Energy and Horsepower

The prime source of energy for a press is usually an electric motor, but this alone is not capable of supplying the rapidly varying torque demanded. A flywheel stores energy which is delivered to it at a constant rate by the motor, although on slower-speed presses, the motor contributes a limited amount of energy during the working part of the stroke.

To illustrate the reduction in motor horsepower achieved by using a flywheel, the saving can in some cases be as much as 12 to 1, *e.g.* a press requiring a 50-h.p. motor with a flywheel drive would need a 600-h.p. motor to supply the peak torque needed for the same machine without a flywheel.

It will be shown later that the flywheel must, as a general rule, supply the energy needed with a limited slow down in speed. This varies with different machines between 10 per cent and 20 per cent.

The total energy stored in a flywheel

$$= \tfrac{1}{2}\, I.\, \omega^2 \quad \ldots \quad (1)$$

Where I is the moment of inertia of flywheel and any attached parts, ω = angular velocity in radians per sec. when the flywheel is running free at its initial speed.

Equation (1) gives the amount of energy expended when the flywheel is brought to rest, but as this never occurs in practice, the expression for the energy given out becomes :—

$\tfrac{1}{2}\, I\, (\omega_1^2 - \omega_2^2)$ Where ω_1 = initial angular velocity in radians per sec.
ω_2 = final angular velocity after work has been done.

Comparing the amount of energy expended for given percentage reductions in flywheel speed, it will be seen that for a 10 per cent reduction in speed 18.8 per cent of the total energy is given out, and for a 20 per cent reduction in speed, 35.5 per cent of the total energy is given out. It will therefore be appreciated that a flywheel of roughly twice the inertia would be needed to produce the same energy for a 10 per cent reduction as for a 20 per cent reduction in speed.

The main reason for limiting the drop in flywheel speed is because of the characteristics associated with induction motors used to drive power presses.

A standard squirrel-cage induction motor is usually designed to give full-load torque at around 4 per cent slip, that is 96 per cent of the synchronous speed, but some induction motors up to 60 h.p., are designed to give full-load horsepower at a lower percentage of the synchronous speed, usually 10 per cent slip.

It has already been shown that the flywheel delivers energy as its speed is reduced, and that on some presses its speed can fall as much as 20 per cent in supplying energy to the press.

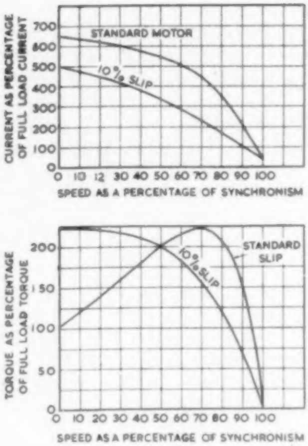


Fig. 7. Typical speed/torques curves

Typical speed-torque curves shown in Fig. 7, indicate that the flywheel slowdown can result in the standard motor developing higher torques and currents than one with a higher slip rating, and in general the higher slip motor is preferred.

For presses over 60 h.p., the press builder can use slip-ring motors, with external slip resistance, which give similar characteristics or alternatively squirrel-cage motors, with rotors having special characteristics.

Continuous stroke presses, for example presses equipped with roll feeds or strip feeds, only use the flywheels to smooth out the peak torque demands, and therefore standard slip motors can be used.

Actual Flywheel Energy Needed For a Press

The flywheel size depends on two basic quantities.

(1) The actual force or tonnage needed in the working part of the stroke.

(2) The distance through which this force has to be exerted.

The product of these two factors gives the energy required.

Any one press can have a range of jobs and they can vary considerably. In a short-stroke single-action press where blanking and shallow raising or drawing jobs predominate, the flywheel capacity can be small, but presses with a longer stroke performing deeper draws, the energy required is much greater, and it should be remembered that on single-action presses with pneumatic blank-holding cushions, energy is required to push down the cushions in addition to that required for deforming the metal.

Double-action presses use very little energy for blank-holding, but the stroke of the inner ram is large compared with draw depth, and again energy requirements can be high.

All these variables make the power press a universal machine, and the flywheel size should be chosen to meet as many of the jobs as possible.

No hard and fast rules can be laid down for fixing flywheel sizes, but the press manufacturers from long experience have their own standards for meeting this problem, and it cannot be emphasized too strongly that the press user should consult the press manufacturer before he selects a press for work, where the energy required is unusually large.

Clutches and Brakes

The clutch and brake are a vital part of the machine, and have perhaps the most arduous task to perform on a modern power press.

It was noted earlier that a press was incomplete without (a) some means of controlling the flow of power from the flywheel (*i.e.* a clutch).

(b) A brake to bring the moving parts to rest after work is completed ; or in an emergency.

The size of the clutch is determined firstly by the amount of torque needed, so that the correct press tonnage can be delivered by the slide at the rated distance from B.D.C. Second, the inertia of the press parts which must be accelerated up to speed when the clutch is engaged.

The size of the brake is fixed by the torque needed to decelerate the moving parts of the press, and bring them to rest in a reasonable time.

Quite a variety of designs are in use on power presses in this country, but are usually divided into two main types :

(1) Positive type.

(2) Friction type.

There is another method which has been used successfully in the U.S.A. but, as yet, no widespread use has been made of it in this country, that is the electromagnetic or eddy-current clutch and brake.

In the positive drive type of clutch, keys or pins are arranged to connect the flywheel to the crankshaft *via* a mechanical linkage to a foot pedal; on the backstroke of the press, a cam device throws out the pins, and a separate fixed spring actuates the brake, bringing the press to rest.

Sometimes the key clutch linkage is actuated by an air cylinder.

The early friction clutches were mechanically operated, usually through a system of toggles, which supplied the clamping force to the friction surfaces.

Most friction clutches today are air-operated, compressed air being fed to a cylinder or similar device, which clamps the friction surfaces together, so that the necessary torque can be transmitted.

Brakes on the other hand, are, without exception, spring operated, the springs supplying the clamping force, so that in the event of an air or power failure, the press is brought safely to rest.

Brakes also have to be interlocked in some way with the clutch, either pneumatically in the case of separate clutch and brake units, or physically with the clutch movement.

Both types have their advantages; the physically interlocked clutch brake is the most foolproof, since it is arranged that when the clutch is on, the brake is off.

The separate clutch and brake have to be "timed" so that overlap between them is avoided, but the arrangement allows for more flexibility in design, particularly with regard to the reduction in inertia of parts to be accelerated.

The design of a friction clutch to transmit a certain torque is fairly straight-forward, but it is not always appreciated that when a friction clutch has to

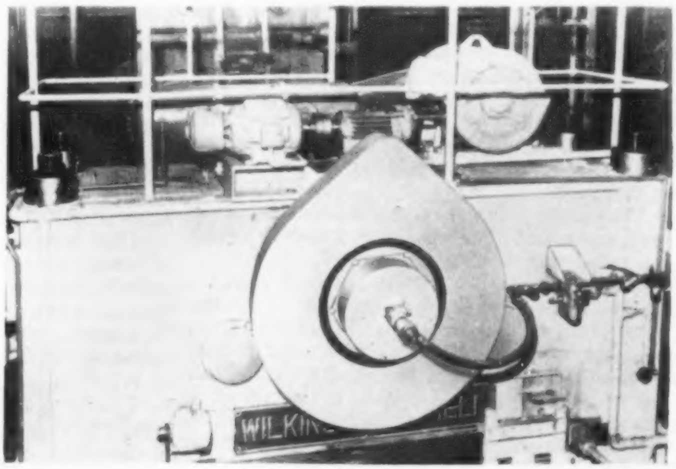


Fig. 8.—The "micro-inching" device, developed to simplify inching on large presses in America, is entirely independent of the main motor and flywheel

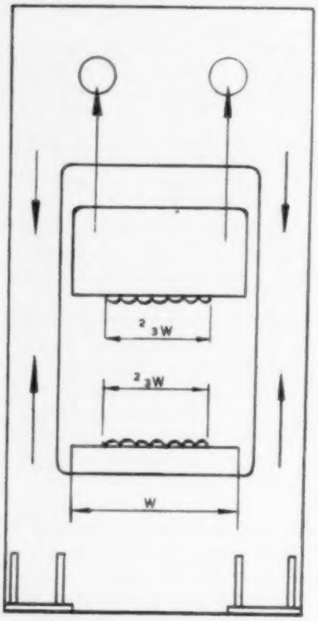


Fig. 9 (left).—The solid or one-piece frame

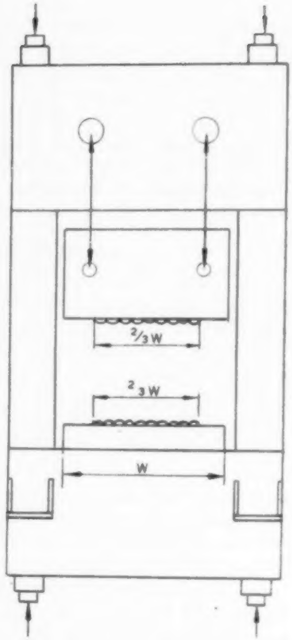


Fig. 10 (right).—Tie-bar or four-piece frame

accelerate up to speed, a substantial train of gears and linkage, a definite amount of energy is lost at the friction surfaces in the form of heat. This also applies to the brake when it decelerates the same moving parts to rest on completion of the stroke.

A single-stroked press has a definite amount of heat generated at the clutch and brake friction surfaces every time the press turns over, and the problem of keeping this within limits calls for careful analysis of working conditions, and is often the major factor in clutch design, particularly with the high working speeds called for today.

Another device associated with the clutch and brake is a sensitive inching device which has acquired the name "micro-inching", Fig. 8. This was developed to simplify inching on large presses in America, particularly under-drive double-action machines, with complex toggle link systems working at high speed.

The inching device is entirely independent of the main motor and flywheel, and is operated through the brake with the clutch disengaged.

When the press is at rest the brake is engaged. The braking torque is taken usually by a circular member directly to the frame. If this member is mounted on bearings and driven by a motor through a sufficiently high gear reduction, the whole press can be turned over at slow speed; somewhere in this reduction gear, there should be a brake to lock the whole gear train, when the press is being used in the normal way.

Usually these inching devices run the press over at very slow speeds, usually at 1 r.p.m. but seldom more than 5 r.p.m.

Some manufacturers claim that an actual pressing can be produced with this device, but of course in this case the motor and gears would have to be large enough to transmit the forces demanded.

Press Frames

The frame of a press must fulfil the following conditions :—

(1) It must provide the reaction forces for the load from the pressing and dies with a limited amount of deflection.

(2) Provide adequate guidance for the press slide with a minimum of deviation from squareness to the bed under load.

(3) Provide all the reaction forces for the gears, flywheel and auxiliaries, such as balance cylinders.

There are many different types of press frame which have been evolved to meet these requirements, but for double standard presses the following three types cover the majority of machines in use in large press shops.

(1) Solid Frame, sometimes known as rigid or one-piece frames. (Fig. 9.)

(2) Tie Bar or four-piece frames. (Fig. 10.)

(3) Underdrive with little or no frame. (Fig. 11.)

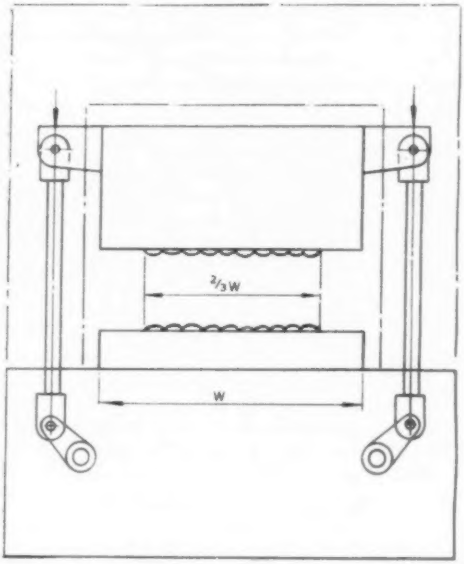


Fig. 11.—The underdrive with little or no frame

Solid Frames

Solid frames are sometimes made from one-piece castings, but today are usually fabricated from steel plate. They are the most economical frame to manufacture, but become unwieldy above a certain maximum size.

The distribution of forces within the frame is shown in Fig. 9, a typical multi-rod press. The main difference between this and the tie-bar frame is that most of the uprights are in tension.

Tie-Bar Frame

The tie-bar frame is made up of four parts, Fig. 10, the crown housing, the transmission, the columns or uprights and the bed. The columns separate the crown from the bed in such a way that the slide, its working stroke and adjustment, and the clearance required for dies and work, is accommodated.

Tie bars complete the structure in the sense that they hold the frame together, in fact they are pre-stressed by shrinking into place, so that they exert a compressive force on the columns, crown and bed.

Some press manufacturers make frame parts of cast iron, but the larger presses today have frames fabricated from steel plate. This allows greater scope in design, since no heavy pattern charges are incurred, and the frames can be made in a variety of sizes to meet the needs of industry.

Since frame members are usually fabricated from flat steel plates, it is logical to expect that they will be in the form of boxes. In the case of the bed, its major function is to take the load from the bottom die, through its structure, and transmit this load to the tie bars, the beam part of the bed usually being of I-section (Fig. 12).

The crown houses the gear drive of the press, and transmits the force from the gears to the tie bars.

The columns are designed to withstand the compressive load from the tie bars, and must do this without undue distortion, since the columns carry the gibs which guide the slide.

The crown and bed are subject to bending moments, and it would appear that a straightforward application of the laws of bending would be sufficient to calculate the stresses and deflection that arise due to these bending moments.

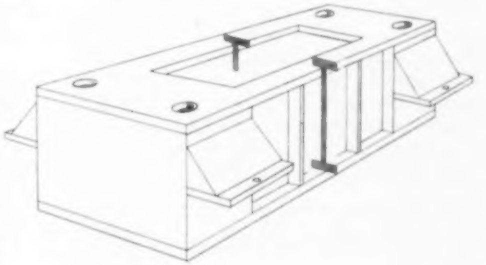
In fact, however, the standard beam formulae only apply with reasonable accuracy to beams having a ratio of depth to span of 1 to 20. Press structures usually have a ratio of depth to span of 1 to 3 or less, and therefore, shear deflections, which can be ignored on beams of normal proportions, have to be considered.

Other complications arise due to rapid changes in stiffness and constraint in the region of the tie bars. These and other factors make the calculation of the deflection very complex, in fact the values arrived at by normal methods of calculation are never very accurate.

Since all presses must deform elastically to some extent, it is obvious that some procedure must be fixed so that press users can expect a reasonably uniform standard of performance from the machines they purchase. Long experience on the part of press builders and confirmed by users both in this country and U.S.A., have led to the following procedure being adopted when calculating deflections in press structures.

(*a*) The load taken is the maximum rated capacity of the press, and is assumed to be distributed over the centre two thirds of bolster, right to left.
(*b*) The effective span of the beam is taken as the distance between the tie rod centres.
(*c*) The bolster of the press should not be taken into consideration as part of the press structure.

Fig. 12.—Typical press bed showing I-section side beams



With all the unknown factors previously mentioned, the calculations for deflection on the basis of the simplified conditions outlined, must only allow a small theoretical deflection. This is commonly fixed for bending only, at 0.001 in. to 0.0015 in. per foot of span.

It should be pointed out here, that elastic deflexion kept within reasonable limits is not wholly an evil thing. Toolsetting on a very stiff press, particularly on jobs that require only a small amount of coining, can be critical. Variations in stock thickness also could lead to damage to vital parts of the press mechanism, if the frame did not yield slightly to compensate for these factors.

Slides

Most of the foregoing arguments apply equally to slide structures, except that the problem is made more difficult by the fact that adjusting gear and knockout equipment has to be incorporated.

A similar proceedure is followed for assessing the loading conditions, *i.e.* the load is assumed to be distributed over the centre two-thirds of the right to left dimension, theoretical deflexions again are fixed at between 0.001 to 0.0015 in. per foot between supports, in this case the connecting rod centres.

The case of a single rod slide is obviously different, here the loading on the slide leads to stresses that are largely compressive. Fig. 14 shows a typical slide.

Function of Tie Rods

The four-piece tie-bar frame is so widely used in press shops, that a description of the function of the tie bars in relation to the other parts of this frame, is called for.

Columns, crowns and bed are machined for proper seating and squareness where they abut, and keys are provided for location in both planes. On final assembly, the tie rods are inserted through the frame members, and shrunk into place.

If this was not done, not only would the stresses in the tie bars fluctuate from zero to full load, but also as most tie bars are quite long they would extend appreciably, and the crowns would lift off the columns with every stroke of the press.

To illustrate the way the load is shared between the frame and tie bars, assume that the frame between the tie bar nuts is incompressible.

If the tie bars are heated to induce a definite amount of expansion x and the nuts tightened to take this up, then at normal temperature the rods will, in effect, be extended by the same amount, *i.e.* dimension x. The rods will then be stressed in tension, the stress being proportional to $\frac{x}{L}$ where L is the length of the bar between nut faces.

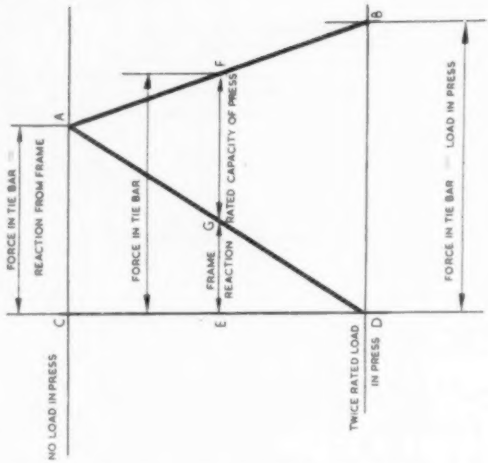


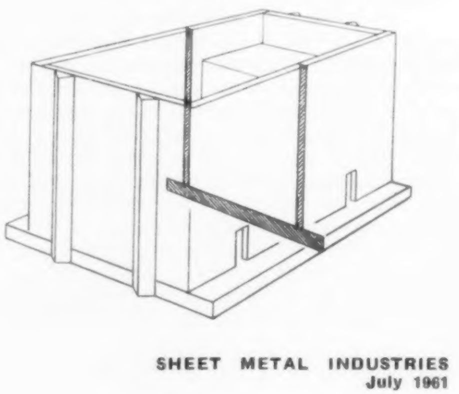
Fig. 13.—Diagram showing variation in tie rod, frame and press load

This tensile stress multiplied by the cross-sectional area of the tie bar, gives the compressive load that the tie bars exert on the frame. Since the frame is assumed incompressible, it will be seen that for the crown to lift off its columns, the press load must be greater than the shrinking load. Furthermore, for press loads that vary from zero to the value of the shrinking load, there is no change of stress in the tie bar.

Of course, the frame is elastic and compresses and when the tie bars are shrunk they reach a position of equilibrium where the reaction from the frame equals the load developed in the tie bars.

The amount allowed for shrinking the tie bars is usually calculated, so that the press load required to separate the frame parts would be 50 per cent to 100 per cent greater than the rated capacity of the press.

Fig. 14.—Typical slide



The way forces vary between tie rod, frame and press load, is illustrated in Fig. 13. The line A.C. represents the condition when the press has no work load, and the forces in the tie bar and frame are in equilibrium. Line A.B. shows how the tie-bar load increases with increasing press load. The reaction from the press frame decreases with increasing press load along line A.D.

The vertical D.B. shows that when the press load increases to twice its rated capacity, the tie rods alone take the load, and the reaction from the frame is zero. In other words, the frame is back to its original condition before the tie rods began to shrink onto it, and the tie rods therefore have been stretched cold to the length they were when hot.

It can also be seen that the variation in the load on the tie bars is represented by A.F., whereas if the tie bars were not pre-stressed, the load they carry would vary between zero and press capacity, so that the range of stress variation is considerably reduced, and can be kept within the capabilities of the steels available.

Tie-Rod Heating

This is usually accomplished by heating the tie bars with a gas torch through apertures in the press frame. This can also be done electrically. Holes are drilled down the centre of the rods, and heating elements inserted. Heat is applied inside the rod, and there are no problems of distortion. If necessary all the rods can be heated together, and is the best way of shrinking the frame.

Shrinkage Allowance

Tie rods are usually shrunk in at 0.0085 in. per foot of length between nuts. This gives approximately a stress of 9½ tons per sq. inch, in the tie bar at the separating point (*i.e.* 100 per cent overload).

The Press and its Auxiliary Parts

Single Action

The important elements of a mechanical power press have already been discussed at some length, but there are other details which make the machine function efficiently, which ought to be discussed. The press user has to choose the machine bearing in mind the type of component he wants to produce. Tonnage, size of die and stroke required are probably the major factors which he has to consider when deciding the size and type of press he requires.

A single-rod press can only have a limited die area, and it is obviously at its best on jobs which are concentric with the die space. Two-rod presses can be made longer left to right, and will deal with off-centre jobs in the right to left direction, while four rod presses take care of front and back off centre loads as well as left to right It must be remembered that any off centre loading must not overload any one connecting rod, since they are designed to take only a proportion of the total load.

On a single-rod press, a reaction force from the gibs is necessary to keep the slide in equilibrium, since the thrust from the connecting rod is at an angle.

On two-rod and four-rod presses it is possible to reverse the horizontal component of the thrust on the connecting rods, by designing the transmission so that the eccentrics revolve in opposite directions ; the reaction force is then contained within the slide, and does not have to be supplied by the gibs. This does not apply when off-centre loading is present, and therefore the gibs have to take some thrust since one side would be loaded more than the other.

Balance Cylinders

Most modern power presses of any size are equipped with balance cylinders, the function of which is not always clearly understood.

The reaction force from the work is vertically upwards, *i.e.* the work resists the downward motion of the slide, but consider what would happen if the slide tools, etc., were not counter-balanced, as the eccentric or crank moved from its T.D.C. position, the weight of these parts would pull on the eccentric and attached gears and reverse the backlash in the gear train, this would also apply to the bearing clearances, big end, small end, etc., which would be clear of their mating surfaces, so that when the tool finally contacted the work, all these clearances, and the backlash in the gears, would have to be taken up rapidly. High impact loads would be developed at the bearing surfaces, and shock loads on the gear teeth. Pneumatic counter-balance cylinders are fitted to take up all these clearances, they push or pull the slide upwards at all times, so that when the work load is developed, gear teeth are in contact on the driving side, big end and small end are in contact with their mating parts, and the slide can do its work without shock.

Slide Guidance

The method of guiding the slide depends largely on the size and type of press, and to some extent on the work to be performed. For instance, a high-speed blanking press would require accurate slide location with a minimum of gib clearance, whereas it is sometimes better to have gibs set with relatively large clearances, when dies are fitted with their own guiding arrangements.

The guiding of the slide is not the only factor to be considered when the question of slide to bolster parallelism is discussed. In the case of the single-rod press the guides are most important, but in multi-rod presses the gears and eccentrics are equally important, because if the eccentrics or cranks are out of step the slide will be out of parallel, no matter how accurate the gibs are. In the case of a four-rod press, this applies right to left and front to back.

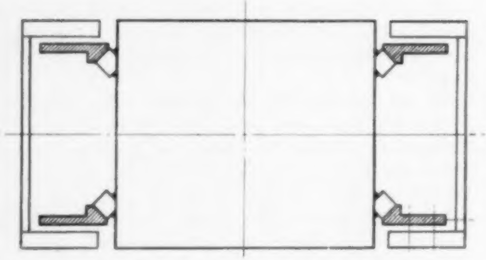


Fig. 15.—Cast-iron gib, with bronze liner strips fitted on the slide ways

The average power press is a relatively large machine, and obviously there are physical limits to the accuracy that can be maintained in practice on large gears and cranks. The amount out of parallel on multi-rod presses is greatest in the mid-stroke position, and least at bottom dead centre, and these facts have to be taken into account when fixing inspection tolerances for slide to bolster parallelism.

The actual gib and slideway arrangements take a variety of forms, but the most common are either 45 deg. gibs all round or a combination of 45 deg. gib and flat gibs. In either case it is usual to provide for adjustment, so that the gibs can be aligned and clearances set as desired. Gibs are usually cast iron, and the ways on the slide are machined and fitted with bronze liner strips (Fig. 15).

Slide Adjustment

Slide adjustment increases the usefulness of the press, accommodating dies of varying heights between the slide and bolster. The amount of adjustment provided can be as much as 24 in. on certain presses.

As this adjustment varies the position of the slide relative to the connecting rod, it will be apparent that it must also transmit the working load of the press, and must be proportioned accordingly. It usually takes the form of a screw and nuts (Fig. 16). On smaller presses the connecting rod is bored and screwed, and a separate screw completes the connection to the slide. To adjust the slide this is screwed in or out of the top casting by hand, but some means of locking must be provided, and is usually achieved by splitting the screwed portion of the top casting, so that it can be clamped onto the screw by tightening up bolts.

On the larger presses this adjustment has to be geared down to help the operator; as size and weight increases, adjustment is sometimes power operated (Fig. 17).

Also on larger presses the two-piece connecting rod has many disadvantages, and a separate screw and nut are generally used. The connecting rod is pivoted in the screw, and the press load is transmitted through the screw and nut to the main body of the slide. The nut rotates to adjust the slide and can be driven by worm, spur or bevel gears at a slow speed, usually at the rate of from 1 to 6 inches per minute.

On multi-rod presses all the screws must be geared together, so that they move the slide equal amounts. Locking is usually accomplished by using a motor with a built-in brake, which is spring operated on when the motor is not running and released when the motor is energized. The motor is push button controlled, forward and reverse. Overtravel limit switches are fitted for adjustment in either direction, since it would be possible to wind the slide right off its adjustment or into the transmission.

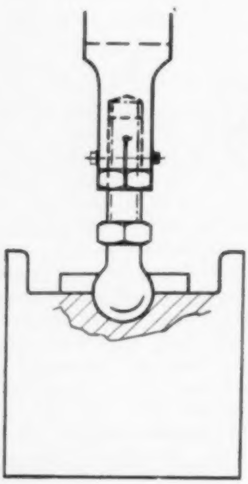
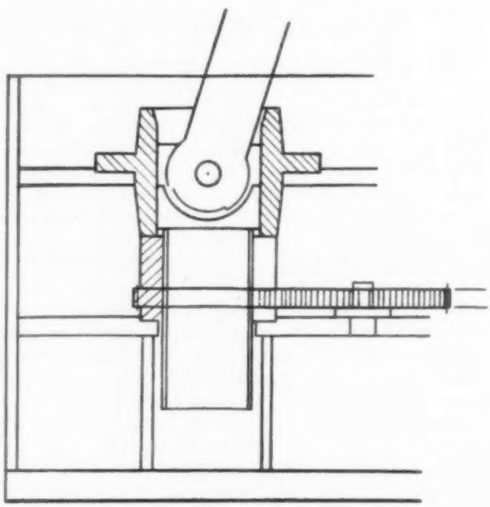


Fig. 16 (left).—One method used to adjust the position of the slide relative to the connecting rod

Fig. 17 (right).—Power-operated adjustment geared down to overcome increases in press size and weight



Pneumatic Cushions

An essential piece of equipment on a single-action press if drawing work is to be performed, is the pneumatic cushion. The method of producing drawn components on a single-acting press is very well known, but is worth repeating.

On such a press, the component has to be drawn over a punch mounted on the press bolster; a draw ring is mounted around the punch so that it can move freely up and down. Pneumatic cushions are mounted in the bed of the press, and exert a gripping force on the stock *via* pusher pins and draw ring when the female top die moves down with the stroke of the press and contacts the upper surface of the stock. Further downward movement of the slide causes the metal to flow plastically over the stationary punch. During this time the stock is gripped between the top die and the draw ring, the force from the press slide overcoming the resistance offered by the die cushion in addition to that needed for plastic deformation of the metal.

It must be possible to vary the resistance offered by the die cushion, since if the blankholding pressure is too high, the metal will tear instead of deforming plastically; if it is too low, the radial compression forces set up in the process will cause wrinkles to form in the drawn component.

The force exerted by the cushion varies directly as the pressure of the compressed air supplied to it, and this can be varied by regulating valves, which will hold the air in the cushion at a specified reduced pressure relative to the shop air line and any pressure between say 10 lb. sq. in. and shop line pressure can be obtained.

Many press shops use large amounts of compressed air, and it is not often possible to guarantee air being delivered to the remoter parts at pressures higher than about 80 lb. sq. in. This should be remembered when specifying cushion tonnages.

Pneumatic die cushions are made in various ways to suit press size and conditions. Essentially they consist of air-loaded pistons and cylinders, the piston or cylinder being attached to the bed of the press. One part is free to move up and down when pushed by the press slide and pressure pins. The maximum stroke allowed is usually half of the press stroke.

For small cushions with symmetrical loading, the guidance provided by the piston and cylinder is enough. For larger cushions, with off-centre loading, it is necessary to provide external guides. These can take the form of separate bored circular guides, or in the case of the larger left to right press, flat milled guideways in the bed, the moving part of the cushion having bronzed ways (Figs. 18, 19 and 21).

The die cushions must have sufficient volume in reserve to limit the pressure rise as the cushions are pushed down. The usual practice is to limit the

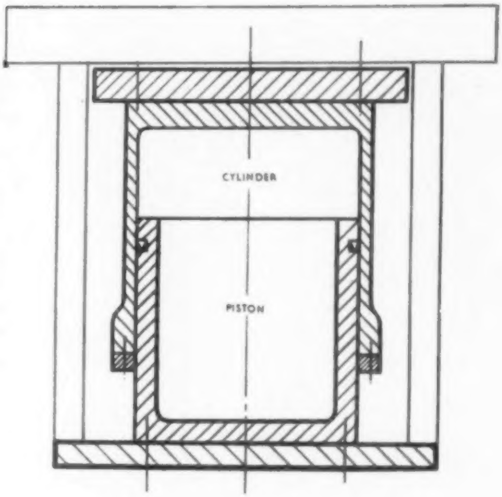


Fig. 18.—Simple self-guided pneumatic cushion

ratio of volume displaced to total volume to 1 : 5. Where the press bed is deep enough, this can be achieved within the cushion itself, if not, the cushions have to be piped to surge tanks.

Again where high tonnages are required in a limited space, double and triple piston cushions may be needed (Fig. 20).

Pneumatic cushions can also be built into press slides, but obviously there are limitations with regard to space available, and tonnage and strokes are limited.

Hydraulic Lock

It is sometimes advisable to delay the return of the die cushions, until the press slide returns halfway on the return stroke. For example, when a component is drawn on a single-action press, normally the top die, draw ring, pusher pins and cushions will be kept in contact by the pressure from the cushions (Fig. 20).

A hydraulic locking device can be fitted to a die cushion by extending a rod fixed to the moving part of the cushion, and connecting this to a piston in a hydraulic cylinder, which is fixed relative to the press. When the press reaches the end of its stroke, oil is trapped on the top of this piston, holding the cushion down. The press slide and top die then return, releasing the pressure on the draw ring. A valve is then opened, which allows the oil trapped in the locking device to escape, and the cushion then returns at an adjustable speed, and gently strips the work from the punch.

The timing of this sequence is controlled by a rotary cam-limit-switch on the press.

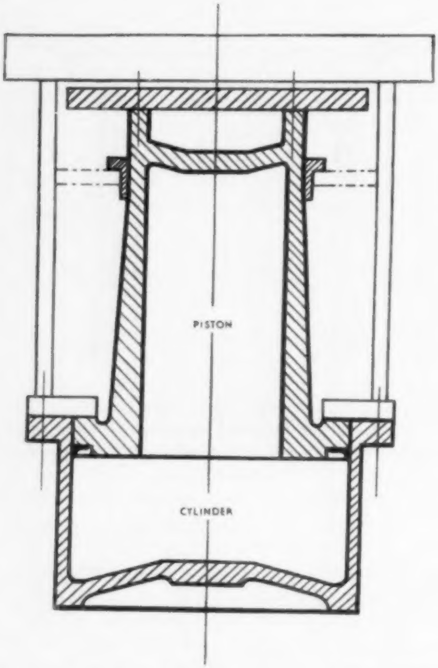


Fig. 19.—Pneumatic cushion with separate bored circular guides

Lubrication

With early presses, lubrication was relatively simple and oil bottles, wick lubricators, ring oil bearings, were used. Over the years these methods have been improved, and on open type presses lubrication pumps are used, which deliver a small measured quantity of oil to the various bearings, which is not recovered.

Pumps may be driven by a separate motor or operated by a moving part of the press. Other centralized lubrication systems deliver a measured quantity of grease or oil to the points required, by means of a hand pump which develops a high pressure. Once again the lubricant is not recovered.

In recent years re-circulation oil-lubrication is becoming a standard feature on larger machines.

The box-type crown of the modern tie bar press makes it easier to adopt this method, and a pump in the base of the machine circulates oil around the various bearings. Some metering device is necessary to ensure that each bearing gets its proper share of oil. After flowing through the bearings, the oil finds its way to the sump in the press bed, where it is filtered and pumped once more through the bearings.

Double-action Press

The obvious difference between a single-action and a double-action press is that a separate slide is provided for blankholding. This slide takes the form of a hollow box, and the draw slide moves up and down within it. The primary gears drive both slides, the inner slide having a conventional crank or eccentric motion. The outer slide is driven by a system of toggle links off the main gears, to give the required motion, and dwell for gripping.

This motion is obtained by suitably arranged toggle links, which successively approach a dead centre position, causing the outer slide to dwell and grip the stock whilst the inner slide completes its stroke, drawing the metal to shape.

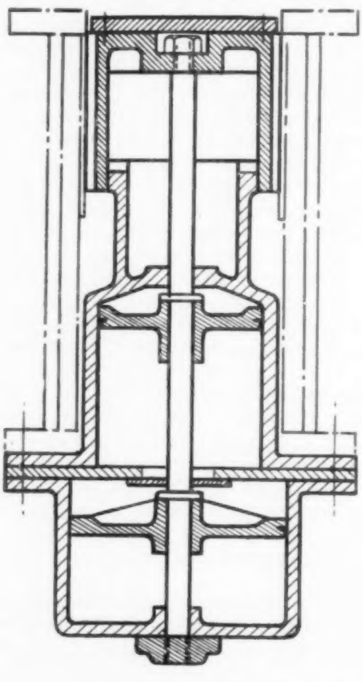
The outer slide moves down to its dwell position meeting the stock when the inner slide is about halfway down its stroke; after the metal is drawn the outer slide remains in the dwell position until the inner slide has moved up. Both slides then return to the top of their stroke.

Also the maximum draw stroke of the inner slide is half of its stroke, although the drawn depth is usually restricted to a smaller amount than this.

Slide adjustment is provided on both the inner and outer slides. The inner slide adjustment is

(*Continued in page* 513)

Fig. 20.—Typical double-piston cushion for use where high tonnages are required in a limited space



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usually power driven on all but the smallest presses, while the outer slide is commonly hand adjusted by screw and nut at each corner, this allows an uneven pinch to be made for gripping the stock.

There is a growing tendency to motorize this blankholder adjustment, in which case a separate pinch adjustment is sometimes built in to the nut and screw which allows individual corner adjustment, the amount is usually limited to a maximum of a $\frac{1}{16}$ inch.

The working speed of the press is dictated by the maximum safe drawing speed for the metal concerned ; for typical steels, this limits press speeds at midstroke to approximately 60 ft. per min. but many press shops are operating at midstroke speeds of up to 90 ft. per min., but in these cases the working part of the stroke is much nearer bottom, where the actual drawing speed is slower.

A typical double-action press, say 33 in. stroke of draw side, 22 in. blankholder stroke, drawing components 9 in. deep would have a press cycle time of 10 seconds (6 spm).

The follow-on single action presses in the same line will run at speeds of about 12 spm, and the double action press fixes the speed of the line.

For the past few years efforts have been made to remedy this situation. Although there is little that can be done about the working part of the press stroke, if the remainder of the press cycle could be speeded up considerable saving in overall cycle time could be effected.

This has been accomplished in a number of ways :—

(1) Special mechanical linkage.
(2) Eddy-current clutch.
(3) Two-speed clutch.

In every case the aim is to give a fast approach of both the blankholder and the draw slide, then slow down the draw slide until work is completed, and return both slides to the top of their strokes quickly.

Fig. 21.—Pneumatic cushion with flat milled guideways in the bed used in larger left to right presses

With the special linkage, the cycle time is fixed ; with the eddy-current clutch, which is an electro-magnetic unit, the clutch runs normally at a fast speed, and is slowed down at the appropriate time by allowing slip to take place, the slow down can be finely controlled and the timing of this is adjustable.

The-two speed clutch arrangement consists of two clutches, which clutch in one or the other of two different gear ratios from a common flywheel; although the gear ratios are fixed, usually 3 to 1, the timing of the clutches can be varied to suit depth of draw.

VACUUM CASTING NOW IN USE AT ROTHERHAM

AN important new technique for the removal of certain impurities from steel during the ingot stage is now in commercial operation at the Rotherham works of Steel, Peech and Tozer, a branch of the United Steel Companies Limited. Vacuum casting enables hydrogen to be removed from the molten steel in a matter of minutes, compared with the hundreds of hours required in the heat treatment of large forgings to achieve a similar effect. For the customer, this means much quicker deliveries.

For vacuum casting, the moulds are contained in a sealed chamber, from which all the air is evacuated. The steel is poured through the top of the chamber, and breaks into a fine spray releasing the hydrogen and other unwanted gases. Steel made in this way is particularly suitable for the production of large section sizes and for other special-purpose steels, where significant improvements in properties can be expected.

Production Procedures at the Beacon Works of John Thompson Motor Pressings Ltd.

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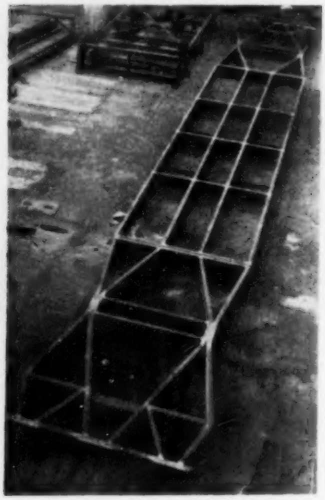


Fig. 13.—Typical railcar underframe, produced from pressed or rolled section up to 60 ft. in length, of riveted or welded construction

chassis make it an economical proposition, but smaller batches are drilled by clamping the member to the table and drilling from a template.

Fabrication

Sub-assemblies such as crossmembers, body-mounting brackets and other frame components, are made from pressings, tubes and plate, which meet up with the sidemembers at a later stage. The flanges, brackets and attachments are cut from plate on straight shearing machines, or where the design demands more elaborate profiles, by flame cutting profile machines. The sub-assemblies are usually jig mounted and welded. Some of the components are supplied in component form to the manufacturer.

Assembly

With the usual John Thompson thoroughness for accuracy all the sidemembers are proved at datum points over their entire length, and both squareness of the flanges and mounting faces are checked. Following this assembly follows the usual pattern with the sidemembers being mounted on trestles and the various crossmembers and gusset plates attached with slave bolts to locate the items which are later removed and replaced by rivets heated electrically and set with a pneumatic hammer.

Finishing

Cold-worked frames and sub-assemblies can be cleaned prior to painting by hot spray and rinse, and members up to 20 ft. can be dealt with in this way. The larger members that have been hot-pressed and subjected to welding operations can have any scale and slag removed by a Wheelabrator airless abrasive shot cleaning plant. The Wheelabrator has been specially designed to cope with the cleaning of chassis frames.

Members are traversed through the cleaning chamber by a power-driven roller conveyor having an effective width of 3 ft. 6 in. and a length of 32 ft. It can be operated to convey the chassis at variable speeds up to 16 ft. per min. The larger members can be brushed or spray-coated by hand and air dried, and as an alternative to the usual chassis black, aluminium or red oxide paints are used.

(*Series to be continued*)

Pressure Economy—Discussion

(*Continued from page* 500)

and this was not easy. It resulted from a combination of tool design and tool materials and also, press design. A press was required that was exceedingly rigid—much more so than a standard press. Also needed was concentricity to a greater degree, and speed. It was a combination of all these factors which made it possible to undertake repeated operations. The importance of the press was too often played down and it was thought that any old press, as long as it went up and down, would do the job.

Mr. Kirk (Samuel Osborne and Co. Ltd.) expressed pleasure at the prominence given in the paper to the question of tool materials. A good deal had already been said on the subject, but here one was giving an exhaustive range of suitable types of steel. It was particularly interesting to note the popularity of the tungsten-molybdenum type of high-speed steels, particularly those with the higher vanadium and carbon contents. Presumably they had been selected because of their greater wear resistance. Also mentioned was a particular type of steel, produced by his company, of the high-carbon, high-vanadium type, but containing cobalt. This was described as being equivalent to AISI type M-3. The one he had in mind was something of an advance on this brand in view of its cobalt content, and higher vanadium content, as compared with the true M-3 variety.

Mention had been made concerning the generation of heat during the cold-extrusion process. It was believed that the inclusion of cobalt could be helpful in reducing the effects on the hardness of the tool in operation. A word of warning should be sounded on the high-carbon high-vanadium types of steels in that they were somewhat more difficult to grind than the conventional high-speed steels, and special care had to be taken in this respect.

Body Assembly Procedures on the CONSUL CLASSIC 315

Some details of Works Practice at the Dagenham Works of the FORD MOTOR CO., LTD.

Introduction

AS will now be known, the 1340cc Ford Consul Classic 315 was announced recently. This new addition to the Dagenham range incorporates several new features such as Lucas twin headlamps, Girling disc brakes, a new type of heater, specially designed Trico "Aeramic" windscreen wiper arms which do not lift from the screen at speed, etc., and its design is such that its success in all markets can be assured.

In the two years preceding its public appearance, this car covered well over one million test miles over some of the fastest and roughest roads in the world—and under climatic conditions ranging from arctic to equatorial.

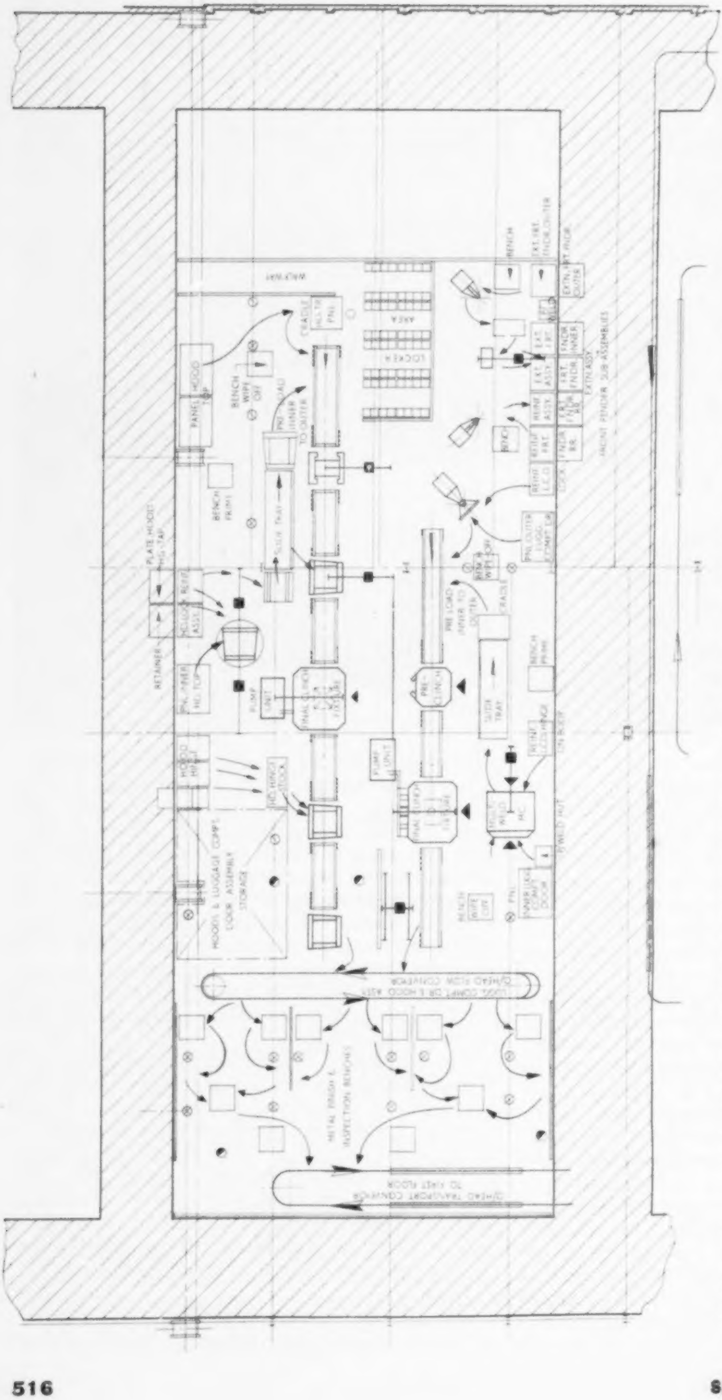
In Africa, one of the prototypes was driven through 23,000 miles of desert and bush at an average speed of 52 m.p.h. in temperatures often approaching the 100° F. mark. In Sweden, severe tests were carried out in temperatures down to 42 degrees of frost. As a prelude to extensive trials over rugged mountain country in central Europe, heavily disguised models were hammered for thousands of miles at top speed on the German autobahnen. A further 20,000 miles were clocked up in various parts of North America.

Ford designers have made a determined effort to meet the widest range of individual market requirements. To take one example—the gear lever; in some areas a gear shift is preferred floor-mounted, while in others, the steering-column type is required for a car of this class. The problem has been met by offering a choice of either kind for the Classic de Luxe. Moreover, in designing their first four-speed column change, a system has been produced which is as positive in operation as many floor-mounted types and which has no trace of the "woolliness" often associated with many four-speed column controls.

The car has an all-welded integral body as is normal practice in modern mass-production cars. Although, in general, production methods on the body of this car are similar to those described in detail in the November 1959 issue of SHEET METAL INDUSTRIES, some additional capacity has been provided in the press shop to cope with the extra volume of production. There is, for example, a line of Danly sliding-bolster presses which allows die setting to be effected in about 20 minutes.

Body Assembly

To see this car being assembled is to appreciate



the immense strength of the body, which incorporates a separate rear frame with side members and cross members to which the rear floor pan is subsequently attached. As many of the machines, *e.g.* clinching fixtures, etc. are similar to those used on the Anglia and other models, this description will not repeat those details that have already been fully described in the earlier description of the Dagenham Works.* The main difference is in the underbody press-weld set-up which is fully described.

According to the Ford Body Group this is the most accurate body ever made at Dagenham, and in particular the panel accuracy from the press shop is very high. Checking fixtures, etc. are exploited to the full at the panel stage.

An unusual feature on the body assembly is the use of certain types of multi-welders on the framing line. Framed-up half doors are used instead of full doors.

As compared with the previous description of Dagenham practice, all the main metal finish lines are now on the floor above the main assembly lines, and there is also provision on this floor for a certain number of hand welding operations prior to metal finish; doors, hoods and luggage lids are also fitted on this floor.

Particularly impressive in the 109E shop is the very good lighting and the high standard of cleanliness.

* See *Sheet Metal Industries*, 1959, November.

Fig. 1.—General layout of hood and luggage compartment door assembly lines, both of which incorporate clinch and/or clinch/multi-weld fixtures

Fig. 2 (right).—*Door clinching and multi-weld fixture*

Fig. 3 (below).—*Applying metal-to-metal adhesive to stiffening member of hood top*

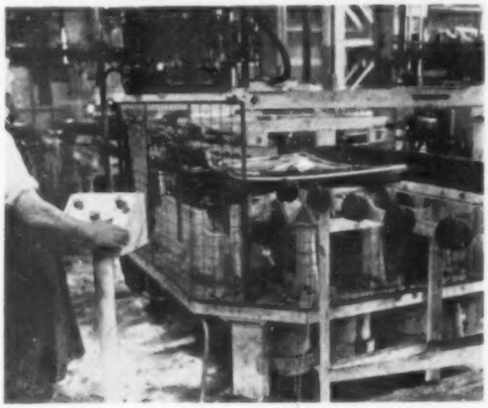
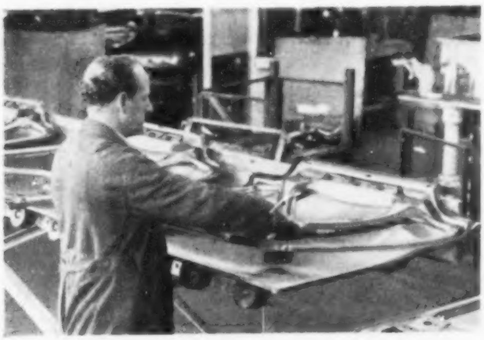


Fig. 5 (above).—*Hood-top after clinching, etc.*

Fig. 4 (below).—*Assembling hood-top components*

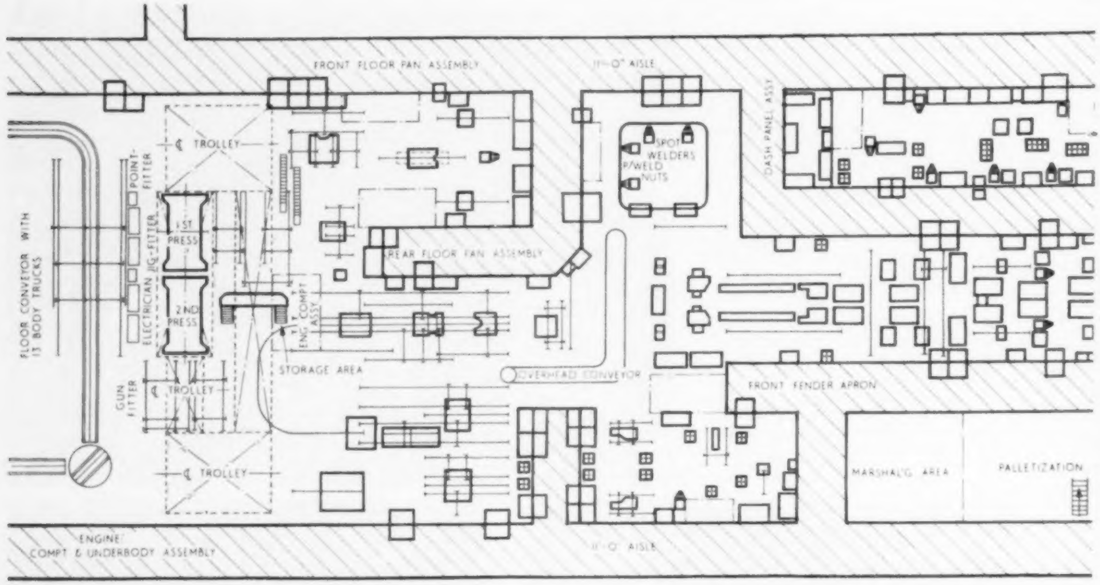


Assembly Sequence

The new Consul 315 is produced both in 4- and 2-door models, but in general the assembly sequence for both models is the same and to a great extent follows the procedures used for the 105E (Anglia) and the Consul-Zephyr-Zodiac models, although the reduced space available (previously referred to) has modified the general set-up to some extent.

Doors

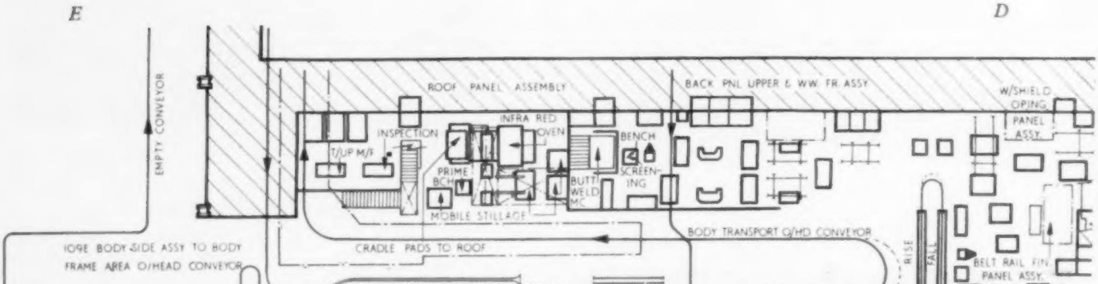
The door assembly procedure begins with a British Federal preliminary clinching fixture at the beginning of a roller conveyor. Into this fixture the outer and inner panels are placed, plastic sealer being applied at appropriate places. The door assembly then passes along the conveyor to a further British Federal clinching fixture which completes the clinching. Following this the clinched flanges

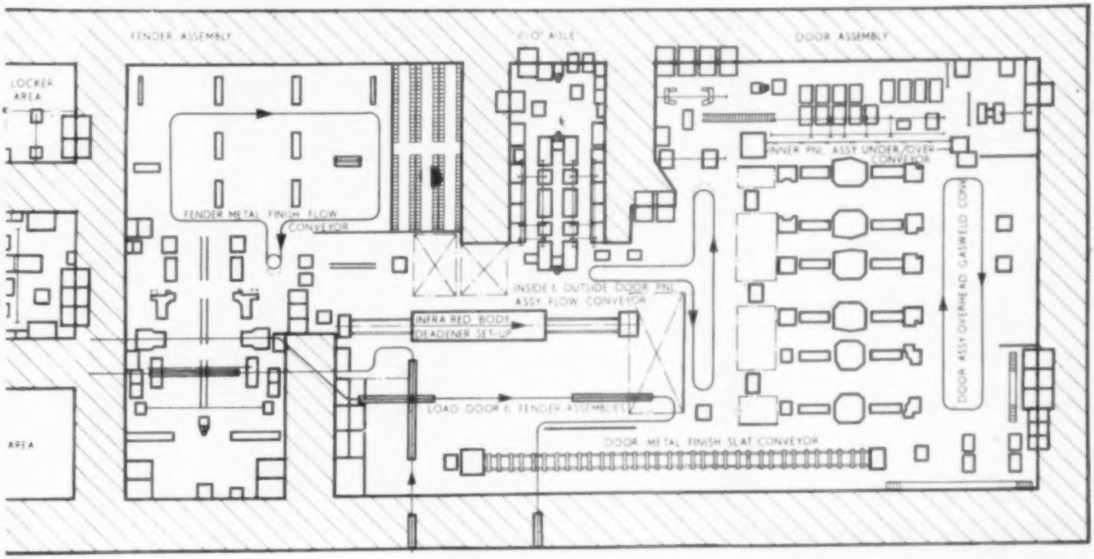


← To C X B

Fig. 6.—Layout of Ford Consul Classic main body assembly section. X shows position of two-stage multi-weld set-up

E D





A

Fig. 6 (continued).—Flow of components is in direction A, B, C, D, E

C

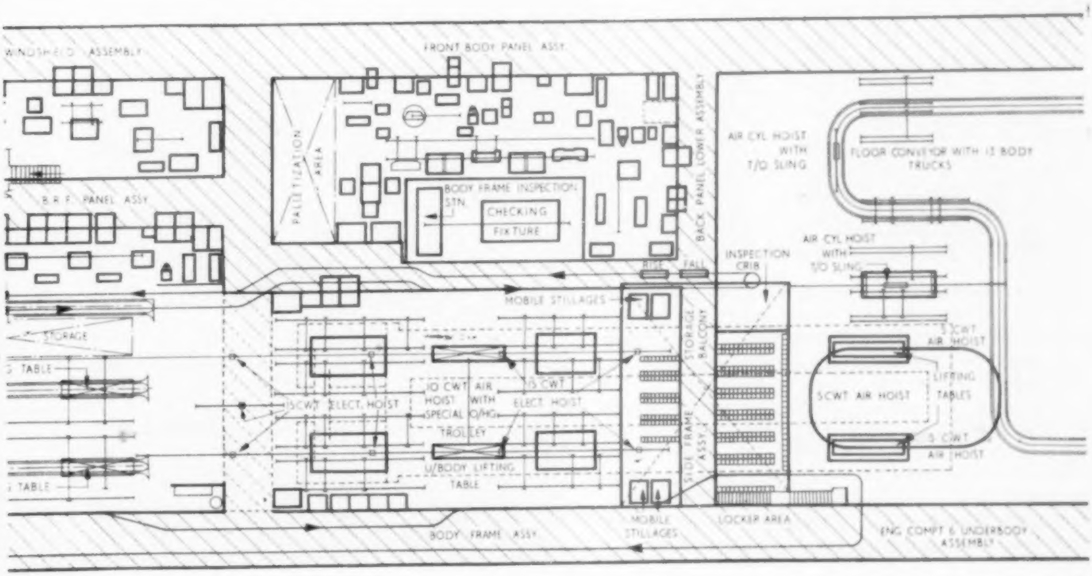


Fig. 7 (right).—Multi-weld set-up for adding reinforcement to fender

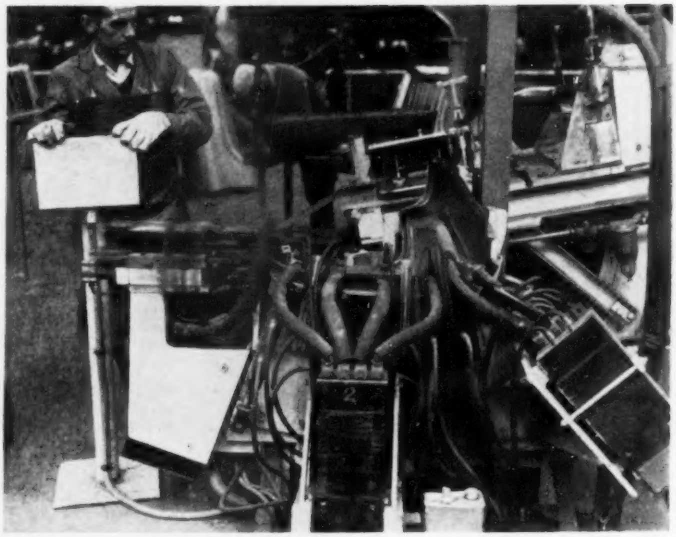


Fig. 8 (below).—Engine compartment assembly

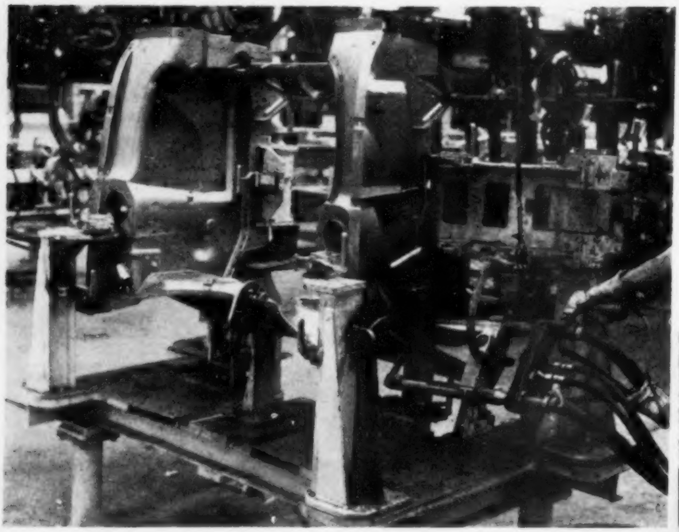
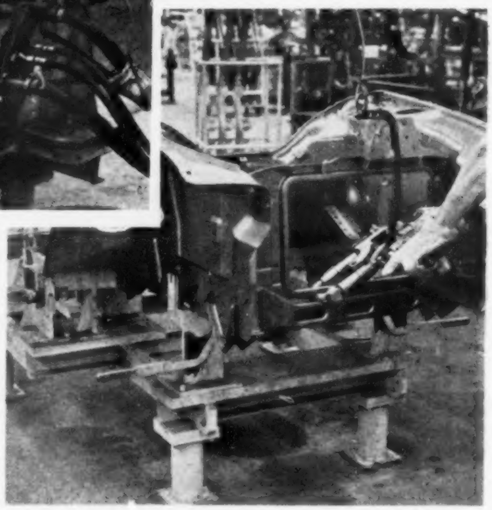


Fig. 9 (below).—Engine compartment assembly



are spot-welded in a British Federal multi-spot welder. The number of spotwelds effected is 16.

The door assembly is then hung on an oval-path overhead conveyor on which various parts of the door assemblies are gas welded and brazed.

The doors are offloaded from this conveyor into automatic machines of Ford design incorporating Thor power tools in which the hinges are added. The machines drive five screws at a time. The doors then pass on to a short metal-finish conveyor on which grinding, etc. of welds is effected. The final operation on the doors is checking in a fixture.

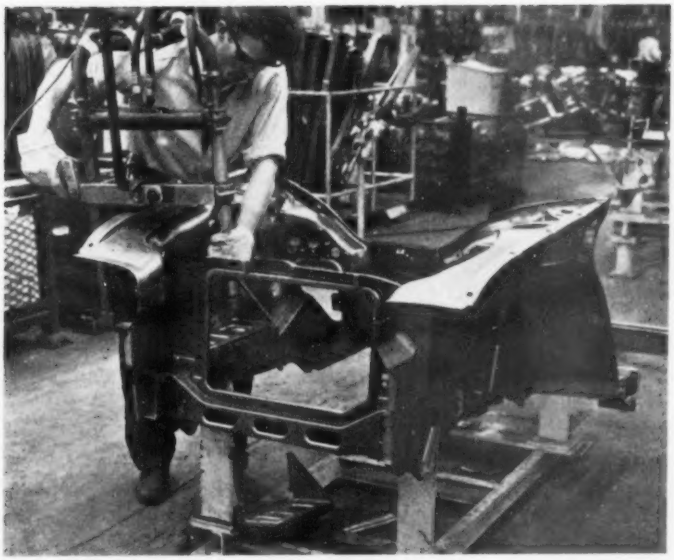
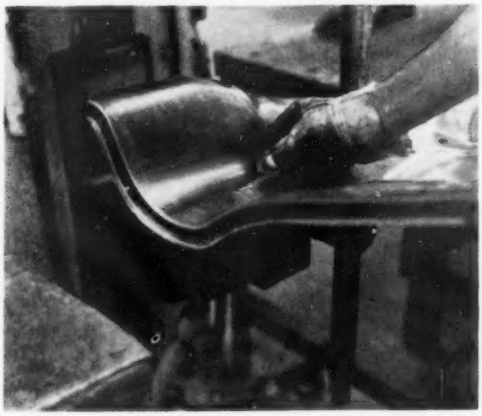
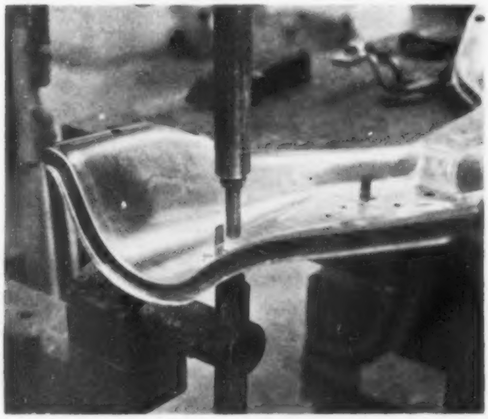


Fig. 10 (left).—Engine compartment assembly

Fig. 11 (a) (below, left) and Fig. 11 (b) (below).—Method used to locate and spot-weld brackets to dash panel to eliminate jigging





All doors and fenders have sound insulation applied. This is in the form of a pad. The components are passed through an electric conveyorized infra-red furnace (MTE) in which the heating causes the insulation pad to adhere to the metal.

Hood

The hood is of two main parts, the main top pressing and the stiffening ribs frame on the underside. Between the frame and the hood pressing plastic metal-to-metal adhesive is applied. The outer panel and the internal frame, after application of the adhesive, are jigged and the outer panel locked to the frame by overhead spot welder. The assembly then passes on a roller conveyor to a British Federal clinching fixture which clinches sides and back edge. On the roller conveyor a fixture is used for gas welding where required, after which the assembly goes onto a short metal-finish conveyor.

This is the first time in this country that metal-to-metal adhesive has been used between the hood panel proper and the internal frame. This procedure eliminates the usual insulation pads.

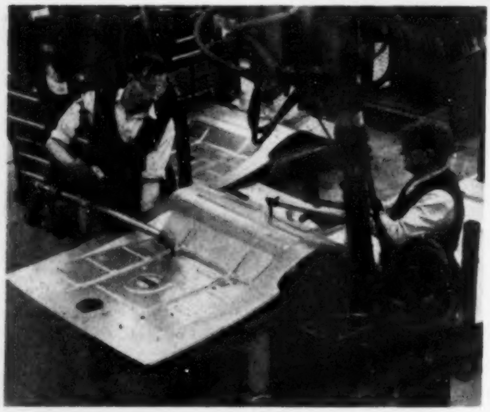
Luggage Compartment Lid

This goes through roughly the same assembly sequence as the hood.

Front Fenders

The operations on these are few. First in a fixture the front and rear reinforcements are added and spot welded in place. The assembly is then

Fig. 12 (right) and Fig. 13 (below).—Floor-panel assembly using two long-throat spot welders



placed in an air-operated fixture in which a partial clinching at certain places is carried out.

The assembly is then placed in a Bigwood Butro set-up where the final full clinching is carried out, followed by multi-welding of the clinched flange. The heads on this machine are air-operated and effect 8 spot welds.

Apron

The two aprons (*i.e.* the pressings that form the sides of the engine compartment) are completed by the addition of various brackets and the front suspension reinforcement. Overhead spot welders are used. A Brookes auto machine drills holes in the apron for engine crossmember attachment and stabilizer bar.

Front Body Side Members

These arrive complete in the assembly area where certain brackets are added by spot welding.

Dash Panel

The main dash panel assembly is effected by floor-mounted AEI 50-kVA spot welders, and to make transfer from one to the other machine the panel is carried in slings on an overhead conveyor. The main additions here are the reinforcement plate for the clutch and brake master cylinders, brackets for the hand brake, dipper switch, heater and the main insulator pad for the front scuttle.

Provision is made for the attachment of brackets by making depressions in the panels during pressing operations. Into these the brackets are located and then spot welded, using, in the case shown in Figs. 11 (*a*) and 11 (*b*), floor-mounted resistance welders. Finally, weld nuts are attached to the panel by A.E.I. resistance welders.

Engine Compartment

This consists first of the two front side members, the aprons and the bulkhead, which are spot welded in a fixture.

The dash panel is placed in a jig, and plastic sealer applied. The previous assembly is then added and spot welded. Primer paint is applied in certain places which are masked from spray guns in later operations.

In a further jig the front seat cross member is added and two short members which carry the jacking tubes.

Rear Floor Frame

This consists of the rear side members, the rear seat cross member and reinforcement and the rear cross member. Assembly is by spot welding in fixtures.

Main Floor Pan

This consists of two half pressings which overlap down the centre line to form a lap joint. The pan pressings, as is normal in unitary bodies, incorporate pressed-in stiffening ribs, foot wells, gearbox tunnel, etc.

Various brackets and the seat reinforcement are added by spot welding to each half pressing and at one point a hole is punched at an angle, in a fixture, by an air-operated punch. The angle of this hole (on the footwell slope) is such as to prevent piercing during the pressing of the panels.

The two halves are jigged in a Ford-designed

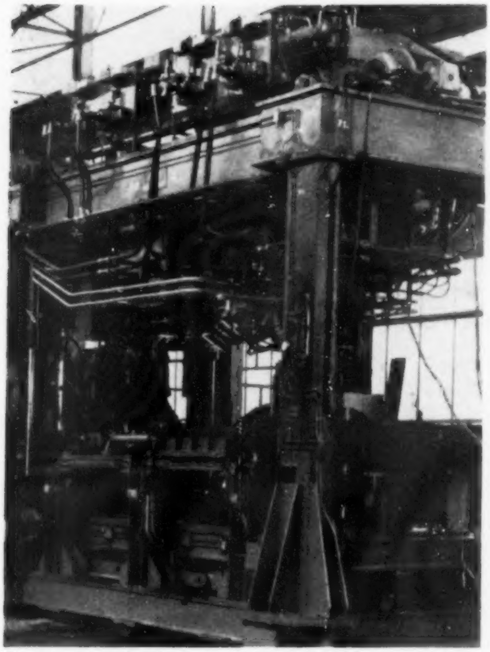


Fig.13.—Completed press multi-welder with upper and lower die-sets in position and ready to operate. A jig trolley is in position on the lower die-set

multi-welder to add weld nuts, etc. This welder allows for the nuts to be added at various positions depending on whether the body is being made for right- or left-hand drive.

In the same fixture two long-throat overhead spot welders are used to join the two halves down the centre-line lap joint. In this operation the one gun operates from one end of the joint and the other from the middle, so that the guns do not interfere with each other.

The assembly is then transferred to another fixture in which the seat reinforcements are spot welded.

Rear Floor Pan

The construction and assembly of this component is similar to that of the main floor pan.

Multi-Weld Sequence

At this stage the various assemblies other than the fenders are brought together in an Electro Mechan-Heat two-stage multi-spot welder. The components, *i.e.* the engine compartment, the rear floor frame and the main floor panels, are loaded onto jig frames where some preliminary tack spot welding is effected by overhead hand spot guns.

Each press consists of a base, a platen and a crown which is supported on the base by four columns. The platen is raised and lowered hydraulically to bring the components into contact with the welding guns suspended from the crown.

The principle of the press-weld set-up is to carry out the welding of the engine compartment and underbody assembly by accurately locating the various sub-assemblies and panels in a suitable jig frame trolley and to pass this frame first through portable weld stations and then through the multi-weld stations.

The layout consists of two parallel lines with cross-over transfers at each end such that the jig frames travel a rectangular path to complete a full sequence.

The parallel lines are each three stations long, the one containing two load and one portable weld station, the other two multi-weld and one portable weld stations. An automatic unload station is incorporated with the cross transfer after welding.

The jig frame trolleys are not fitted with wheels but transferred from station to station *via* a series of fixed rollers which are arranged so that they provide a continual track for the trolley and also control the lateral movement during transfer.

The initial movement from a station is obtained by air cylinder which pushes the trolley into continually-running friction drive wheels which complete the station-to-station transfer. Final positioning in each station is obtained by a separate air cylinder.

Multi-Weld Stations

Hydraulically-operated presses are used, with a bed area of 149 in. × 86 in. clear of uprights, and a platen stroke of 46 in. The construction consists of fabricated assemblies keyed and bolted together with the complete hydraulic unit mounted on the crown.

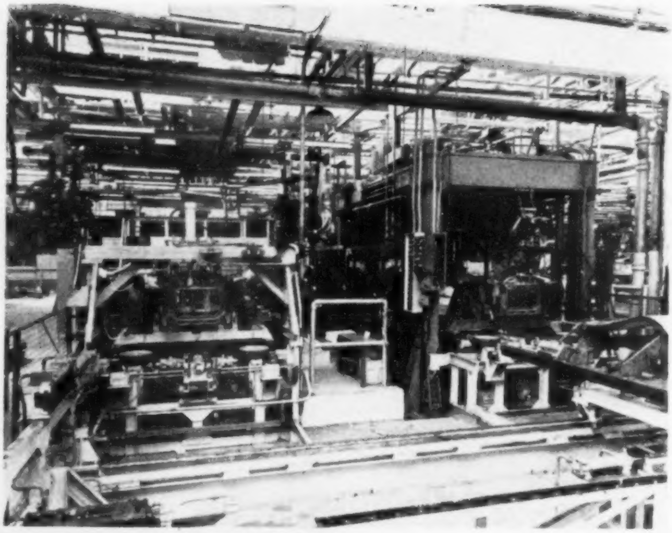
The presses are designed for a maximum table stroke with minimum overall height. The platen movement is obtained from four cylinders suspended from the press crown and to assist in maintaining the platen parallel to the base during the press stroke these hydraulic cylinders have their oil supply metered.

Racks fitted to the uprights and pinions fitted to the platen are the controlling factors in minor axis parallelism and relative to the major axis a series of over-centre links are fitted between the platen and the bed with a suitable frame tieing the links together. This mechanism also serves to react the gun load during the weld sequence.

Each press station has a complete die-set, *i.e.* the welding back-ups are not mounted on the trolley but form a lower die-set mounted on the press platen. The upper half of each die-set contains all the welding transformers, welding guns and index mechanisms including the necessary hydraulic manifolds for guns and index cylinders and cooling-water manifolds for electrodes.

Single index (two weld positions), double index (three weld positions) and triple index (four weld positions) mechanisms are incorporated in the die-

Fig. 14 (right) and Fig. 15 (below).—Two views of the Electro Mechan-Heat two-stage multi-weld equipment, for the under-body assembly



set design. The single index is obtained by one cylinder, but the double-index and triple-index units each incorporate two cylinders connected to the slide *via* a lever. By mounting one cylinder at the top of the lever, one cylinder in the centre of the lever and attaching the bottom of the lever to the gun slide, three or four weld positions are obtained, dependent on how the two index cylinders are extended and retracted.

Weld current is switched *via* ignitrons and controlled by timer devices. The electrical supply for welding is a 400-volt, 3-phase, 50-cycle supply, and the transformer firing is such that only one transformer per phase is selected at any one time. Selection is by three-pole magnetic contactors operating off load. The total die-set transformer content is therefore fired on the cascade principle.

The lower half of each die-set contains the lower electrodes or back-ups and to permit easy location of assembly these back-ups associated with "U"-section members are arranged to rock in and out, a motion achieved by having the back-up mounting brackets pivoted and operated by cams.

The duty cycle is such that it is not considered necessary to cool these lower electrodes.

Underbody Transfer Sequence

Assuming that the sequence commences with an empty trolley in the first stage, the operator first loads into locations on the trolley the following components:

1. Engine compartment assembly.
2. Rear floor frame assembly.
3. Body side lower edge reinforcements.

When these loading operations are complete, the operator depresses palm buttons to energize the ejector solenoid. The ejector cylinder moves the trolley forward until the front end of the trolley is just past the centreline of the first pair of constant-running friction drive wheels. At this point a limit switch is operated to enable a cylinder to force the drive wheels outwards against the inside edges of the trolley. The trolley is thus transferred forward into a second set of rollers, which are brought into engagement on the trolley sides by the method described previously.

As the rear of the trolley approaches the drive

wheels, the limit switch is released, thus de-energizing the solenoid operating the drive wheels, and the wheels are disengaged from the trolley sides. As the second set of drive wheels releases the trolley, a locating lug on the underside of the trolley engages in the latch mechanism of the waiting-stage ejector cylinder. At this point the operators in the third stage may depress palm buttons to eject the trolley from the waiting stage through a further set of drive wheels into stage three.

As the trolley reaches the final position in stage three, it is accurately located fore and aft *via* a short-stroke gather cylinder. With the trolley positioned exactly, another set of palm buttons is depressed to swing down a set of toggle clamps to clamp the engine compartment. The operators also swing over two hand clamps per side to clamp the body side lower edge reinforcements.

The operators then carry out the required portable welding operations to weld the body side lower edge reinforcements to:

1. Dash panel.
2. Front jacking bracket reinforcements.
3. Front jacking bracket members.
4. Front floor cross member.
5. Rear jacking bracket reinforcements.

The operators then release the four hand clamps, then load:

1. Front floor pan assembly.
2. Rear floor pan assembly.

At the completion of the above loading operation, the overhead clamps are released by means of palm buttons. The trolley can now be ejected into the cross-transfer by the operators' palm buttons. As the trolley approaches its final position in the cross-transfer stage, it is moved into its correct location by means of a positioning cylinder.

At this point the trolley and cross-transfer carriage are transferred across to the press-weld line by means of a chain drive. The initial movement is carried out by a cylinder in order to relieve the motor of much of the starting load. As the cross-transfer carriage approaches the press-weld line, the motor drive cuts out by means of a limit switch and the final positioning is carried out by a positioning cylinder.

The jig frame is then ejected backwards into the press-weld line, and is automatically located in the first press-weld station, where the rear floor pan is welded to:

1. Back panel lower extension.
2. Rear cross members.
3. Right- and left-hand rear spring stop retainer.
4. Front floor rear cross member centre reinforcement.

The left- and right-hand front floor pan is welded to:

1. Front floor rear cross member centre reinforcement.
2. Right- and left-hand front jacking bracket member.
3. Right- and left-hand body side front member.
4. Dash panel.

The total number of spot welds is 100, the total number of guns is 46, the total number of transformers 14, and the total number of index units is 4 triple housing 18 guns.

The jig frame is then transferred to the second press-weld station automatically, located, and the following welding carried out:

Rear floor pan to:

1. Back panel lower extension.
2. Rear cross member.
3. Right- and left-hand body side rear members.
4. Right- and left-hand body side lower edge reinforcement.
5. Front floor pan rear cross member centre reinforcement.
6. Right- and left-hand rear spring stop retainer.

The right- and left-hand front floor pan is welded to:

1. Front floor cross member.
2. Front floor rear cross member centre reinforcement.
3. Dash panel.

The total number of spot welds is 108, the total number of guns 56, the total number of transformers 13, and the total number of index units 15, 4 double housing 20 guns and 3 single housing 12 guns.

At the completion of the second press-weld cycle, the trolley is transferred into the next stage automatically. This is a second portable weld station and here the operators weld the rear floor pan to:

1. Body side rear members.
2. Rear spring stop retainers.
3. Front floor rear cross member reinforcements.
4. Rear spring front hangar brackets.
5. Rear spring stop retainers.
6. Body side rear members.

and weld the front floor pans to the front floor cross member reinforcements.

When the portable welding has been completed, the operators depress palm buttons to eject the trolley onto the cross-transfer carriage, the trolley position being finalized as before by means of a positioning cylinder. With the trolley correctly located, air-operated ejectors are brought up beneath the underbody to raise it above the trolley.

When the ejectors reach their upper limit, gate rails pivot up in front of and behind the trolley, to allow a pair of beams to be driven in beneath the underbody but above the trolley. At the forward limit of travel of these beams, the ejectors are retracted, thus lowering the underbody onto simple locations on the beams. The beams are then driven out to their rest position.

With the underbody removed from the trolley,

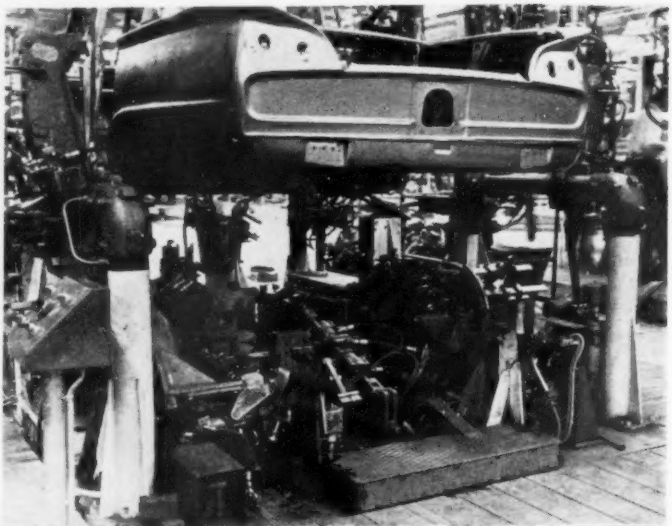


Fig. 15 (right).—Typical multi-weld set-up for body components

Fig. 16 (below).—General view of part of Consul Classic assembly line. In left forefround is lift bringing underbody from under floor conveyor. In right foreground underbody and balloon assembly are joined in fixture in which underneath welds are effected by multi-welder built into fixture. Above-floor welds are completed by hand spot-welders

and the beams retracted, the gate rails are lowered to clear the trolley. It is then cross-transferred to the press-weld line in the same way as described previously. When the trolley has been ejected from the cross-transfer carriage, the carriage is then reversed to its original point to await the arrival of the next trolley.

With the beams at their fully-out position, locating pins are extended *via* small air-operated cylinders to locate in the four jacking brackets. The turnover fixture can now be operated *via* the operator's palm button to traverse the underbody through 180 deg. to a skid on the conveyor. On reaching the skid, the locating pins are retracted and the underbody is deposited onto the skid. The turnover then returns automatically to its pick-up position.

All stages of the system are completely interlocked so that only when a particular stage is clear, and all its moving parts reset, and all fouling clamps etc. are in a safe position, can a trolley be transferred from the previous stage, whether by hand or automatically as dictated by circuit requirements.

Final Assembly

From here the assembly is put on a trolley on a continuous floor conveyor set down in an L-shape.

Fig. 17.—Body-in-the-white nearing completion

On the conveyor all final underneath welds, both spot and gas, are carried out, and the assembly turned over and the same carried out on the top side. The complete underbody assembly then goes to one of two elevators which lowers it onto the underfloor conveyor which takes the underbody to a further elevating platform which raises it at the appropriate point further in the assembly line, *i.e.* on the framing bucks.

The body sides reach the framing bucks by overhead conveyor. First the body sides, the windshield opening panel, belt rails, back window, and the lower back cross panel, etc. are assembled by spot welding. The rear side edge of the quarter panels is left raw and is gas welded direct to the rear back cross panel.

This assembly is then placed by overhead conveyor on the underbody assembly which is elevated from the below-floor conveyor. Parts of the body sides, *e.g.* the side reinforcement, are in zinc-coated sheet as certain areas cannot be reached by subsequent painting. Prior to lowering the balloon, plastic sealer is added to the underbody where required.

The complete assembly of underbody and balloon goes into a master welding jig. This is an unusual set-up in so far as the underneath welds are made automatically. The hold-down on this set-up is pneumatic. The welding heads underneath are under the main floor pan and round the radius of the wheel arches. The heads index forward in three positions for welding and then back again in three different positions. Thus each head effects six close-pitch welds. However, initiation of the automatic welding sequence is not effected until hand spot welding is carried out on top of the assembly. These operations are the usual ones at this stage of assembly.

The assembly, on a trolley, then goes to a lift table which, when raised, allows further underneath spot welding to be effected by hand spot welding. There are two lift tables here at the beginning of two final assembly lines. The table, when lowered, allows the trolley to pass onto a floor chain conveyor, on which the first operations consist of further hand spot welds. At the next station the roof panel is added and spot welded to hold in place, after which seam welding of the roof panel is effected

Further gas welding and brazing operations are completed, and from the windscreen opening panel, pressed originally with two supporting strips from the top to the bottom edge, the two supporting strips are cut out, leaving the full windscreen aperture.

At this point the body is painted with primer at other areas inaccessible to subsequent painting.

From the floor conveyor the assembly is offloaded onto an overhead conveyor and passes to the floor above.

Here the body again is lowered onto a trolley on a floor chain conveyor. The next operation is to apply plastic anti-noise strip to the body on the junction line of the front fenders (wings) to apron panels.

Following this the doors are hung and the boot lid hinges added. Special locating jigs ensure the correct positioning of the boot lid on the hinges.

These jigs are then removed following which the fenders are bolted on.

The hood is then added, followed by the usual metal-finishing operations as described for the 105E. The small amount of solder loading mainly around the rear gas-welded joints previously referred to, is then effected and the bodies pass through a solder disc booth of the type also used for the 105E.

The final operation is through a Modernair sodawash booth, after which the bodies pass through the air-conditioned tunnel to the paint-trim and assembly building. The painting and final assembly operations are more or less identical to those for the 105E. However, a support strip is attached to each centre door pillar and follows the underside contour of the roof from which it is separated by insulating material. This effectively prevents roof drumming and gives additional strength.

(*Continued in page* 540)

An Introduction to the

THEORY AND PRACTICE OF FLAT ROLLING—10

By the late C. W. STARLING, B.Eng., A.M.I.Mech.E.

(*Series concluded from page* 457, *June*, 1961 *issue*)

As readers will no doubt be aware, this series of articles, of which this instalment is the last, will be published in book form in the near future by the University of London Press and the Editor will be pleased to forward to the publishers any enquiries relating to the book.

METALLURGICAL QUALITY CONTROL

CONTINUOUS hot- and cold-strip mills are capable of rolling a wide variety of flat-rolled products from very soft mild steel to high-alloy stainless steels. However, by far the greatest output of continuous strip mills is mild steel for the production of car bodies, wheels and chassis frames, containers, from light tanks, drums and gas bottles to cans, refrigerators, washing machines, vacuum cleaners, furniture, holloware and other vitreous-enamelled products. Also metal sections for building construction. This final chapter, therefore, only deals with the metallurgy of mild steel in sheet and light plate form.

In spite of the wide variety of products, the steel base in about 90 per cent of them is dead-soft mild steel of which a large tonnage must have a high degree of ductility to conform with the stringent demands of deep-drawing operations. Another vital requirement is a surface completely free from any defects which would (a) act as a stress raiser and thus cause premature failure in pressings, or (b) reveal itself in the finished part, *e.g.* outside panels of motor cars. It is unfortunately true that surface defects are highlighted rather than masked by painting. The third important requirement is uniformity of gauge, as this is of great importance in mass production of deep-drawn pressings.

In the U.K. and in U.S.A. deep-drawing steels are rarely supplied to a specification but to do a particular job, and the quality required from a commercial point of view is a matter of agreement between the supplier and the user. Table I shows approximately the commercial captions for light plates and sheet. Commercially there are only two grades of plates and hot-rolled sheet and four grades of cold-reduced sheets, namely, two grades of steel quality, each of which has two grades of surface quality. Plates and H.R. sheets may also be supplied to a stringent surface quality after pickling.

Since D.D. quality covers everything from flat work to moderate pressings and E.D.D. covers a wide range of deep-drawing pressings, the metallurgical department decide the grade and route the order in accordance with the severity of the pressings. The fewer grades of steel, the easier it

TABLE I—*Commercial Captions*

Plate	Sheet	
	H.R.	C.R.
D.D.	D.D.	G.P., D.D. F.F., D.D.
E.D.D.	E.D.D.	G.P., E.D.D. F.F., E.D.D.

TABLE II—*E.D.D. Steel*

	Specification (per cent)	Typical Analysis (per cent)		Specification (per cent)	Typical Analysis (per cent)
Carbon	0.07 max.	0.06	Nickel	0.10 max.	0.06
Silicon	—	0.002	Copper	0.10 max.	0.07
Sulphur	0.027 max.	0.025	Tin	0.020 max.	0.01
Phosphorus	0.015 max.	0.012	Nitrogen	—	0.0045
Manganese	0.32/0.42	0.35			

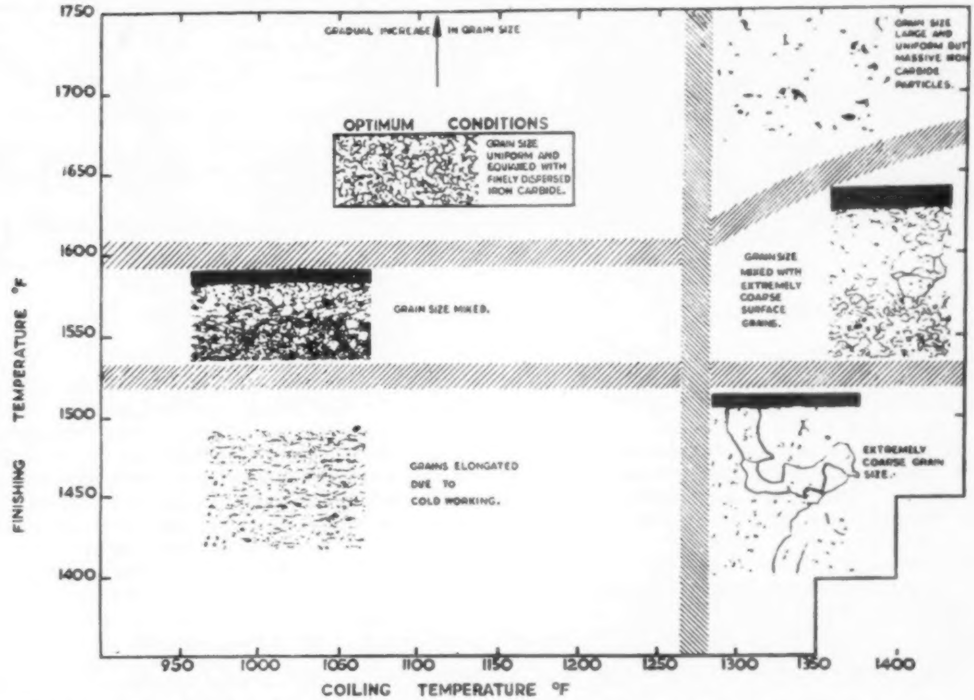


Fig. 152.—Effect of finishing and coiling temperature on structure (magnification X100 except micrograph in top right-hand corner which is X400)

is for the mill's production department, but on the other hand the more stringent would be the requirements placed on the melting shop. Accordingly, the number of grades of steel routed by the metallurgical department depends upon local circumstances. From the metallurgical point of view the problem is the production of the highest quality required and subsequent discussion will be confined to this quality.

The specification and a typical composition for basic open-hearth steel are shown in Table II.

Apart from relatively small quantities for stabilized grades rimming steel is used exclusively for deep drawing. There are three main reasons for this :—

(1) A better surface can be obtained because of the rimming action flushing the steel free of inclusions near the surface.

(2) The rimming action itself reduces the carbon by as much as 0.015 per cent or more, and this is a much cheaper way of obtaining very low carbon, than in the furnace.

(3) The addition of ferro-silicon to produce a balanced or killed steel would increase the tensile strength beyond the acceptable limits.

In order to obtain the composition shown, the pig iron should contain low residuals, for example, nickel, copper, chrome and molybdenum, since these are not removed in the furnace. Sulphur and phosphorus should also be as low as possible to reduce the metallurgical load in the open-hearth furnace. Similar remarks apply to the scrap used. The nitrogen content is uncontrollable, and is generally of the value shown for all open-hearth steels.

In the melting shop the problem is to obtain low carbon, sulphur and phosphorus contents in a reasonable time. This is achieved by melting the charge under a basic slag which removes the sulphur and phosphorus. Ore additions are made to reduce the carbon content and in modern plants this is supplemented by oxygen blowing by lance or jet. During the melting and refining process the manganese is almost entirely removed by deoxidation, and the steel having a low carbon content is in a highly oxidized condition. Accordingly, ferro-manganese and controlled amounts of aluminium or ferro-titanium are added to the ladle into which the steel is tapped, to produce a steel which will

Table III—*Analysis of Rimming Steel*

Position down Ingot (per cent)	C (per cent)		S (per cent)		P (per cent)		Mn. (per cent)	
	E	C.	E	C	E	C	E	C
10.5	0.050	0.070	0.011	0.057	0.007	0.027	0.28	0.29
15.0	—	—	0.010	0.042	0.010	0.022	—	—
20.0	—	—	0.011	0.035	0.008	0.020	—	—
25.0	0.050	0.070	0.012	0.033	0.009	0.020	0.31	0.32
30.0	—	—	0.010	0.032	0.013	0.021	—	—
50.0	0.050	0.055	0.013	0.027	0.014	0.019	0.30	0.30
70.0	—	—	0.014	0.022	0.011	0.013	—	—
80.0	—	—	0.014	0.020	0.011	0.014	—	—
90.0	0.050	0.055	0.013	0.017	0.012	0.015	0.30	0.30
93.5	—	—	0.013	0.015	0.013	0.016	—	—

give a level rimmer when teemed into the ingot moulds.

The surface quality of the steel depends to a large extent upon the careful control of the teeming operation to avoid numerous ingot surface defects. These are fully described and illustrated in the Iron and Steel Institute Special Report No. 63.

When E.D.D. steel is required to be non-ageing (this is discussed below), stabilized steel, *i.e.* steel killed with aluminium to give a residual aluminium content of 0.025 per cent to 0.050 per cent is used. Normal practice is to add the necessary aluminium to the ladle. The next stage is the transfer of ingots to the soaking pits, where they are heated uniformly to the rolling temperature.

The temperature in the soaking pit is not critical, but it should not be so high that the outer skin of the ingot is molten and running down to form slag in the soaking pit. A usual temperature for mild steel is 2400°F. (1315° C). Apart from the temperature in the soaking pits, time of soaking is important and this depends on the track times, a Table of which has already been given in the previous chapter. Provided these times are not exceeded by too great a margin, they are not

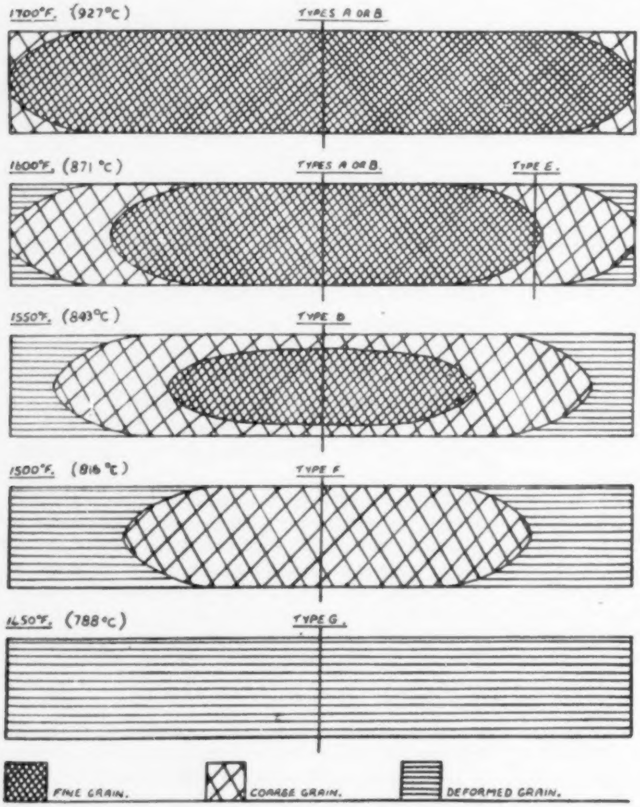
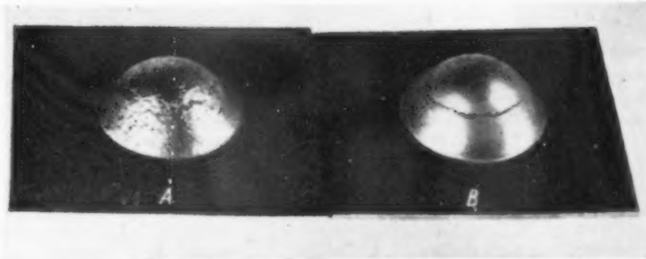
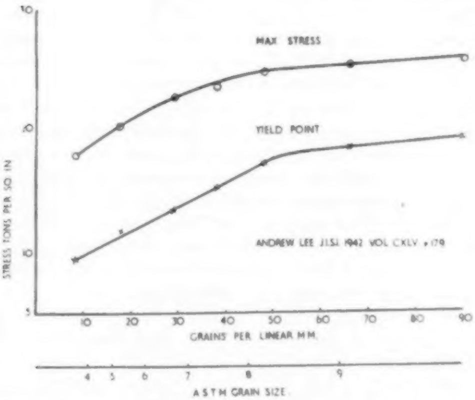


Fig. 153.—Typical transverse cross-sections through the ends of hot-rolled coils

Fig. 154 (below).—*Effect of grain-size from A.S.T.M. 4 to A.S.T.M. 9 on yield point and maximum stress*

Fig. 155 (right).—*(A) coarse grain, and (B) fine grain revealed by Olsen test*





critical. One point to watch, however, is that the track time does not fall below a recommended minimum which is usually $2\frac{1}{2}$ hours.

After leaving the soaking pits, the ingots are presented to the slabbing mill as quickly as possible and rolled down to slabs in the shortest possible time. Apart from the heat radiation from the slabs at this elevated temperature, there is the heat given up to the rolls and the roll cooling water and the temperature tends to fall rather quickly. It is possible, if there are no delays whatever, to roll straight from the slabbing mill into the strip mill after shearing the top and bottom crops, but it is difficult to obtain the finishing temperature required in this case and it is more usual to cool the slabs to enable them to be properly inspected and held in the slab yard to make up optimum rolling schedules for the strip mill. Almost invariably, the slabs are allowed to cool at their natural rate, although it is possible in the case of some special alloys to pile the slabs close together and so slow down the rate of cooling. In the case of mild steel, the cooling rate of a slab seems to have little effect on the final properties and it is not inknown for the slabs to be cooled by water sprays.

The slabs are reheated in the slab furnace to a temperature of 2250 to 2350° F. (1232 to 1288° C.) and held at this temperature for a sufficient length of time for the temperature to be uniform throughout the slab. They are then passed through the roughing mills during which the temperature drops to 1900 to 1950° F. (1038 to 1066° C.) on the delay table between the roughing mills and the finishing train.

The slab then passes through the finishing train, and the strip is in all six finishing stands simultaneously. Between each stand water jets keep the sheet free from scale.

A radiation pyrometer between the 9th and 10th stands, that is, the last two stands, records the finishing temperature. The strip then passes along the run-out table and is cooled to the required temperature by a series of water sprays. A pyrometer records the temperature of the strip immediately before coiling.

Provided the slab has been adequately scarfed, the rolls are in good condition, and the cleaning sprays have functioned satisfactorily, the surface of the strip should be excellent. But there is another hazard—rough and cracked edges. Such edges coming in contact with the guides in the finishing stands and at the coiler may cause small pieces of metal to be knocked off and fly on the strip surface and to be rolled therein leaving eventually pits and scrap marks. Torn edges can arise from mill conditions such as excessive spread, but another cause is red shortness due to too low Mn/S ratio. For strip-mill practice this should not be less than 10 in rimming steel. With killed steels the ratio may be somewhat lower.

For hot-rolled plate or sheet the coil is transferred to decoilers and cut up lines including a light skin-pass for gauge $\frac{3}{16}$ in. or less, to remove coil breaks. This process is discussed under cold-reduced coils.

The factors which determine the mechanical properties of mild steel sheet and strip are chemical composition, grain-size and structure and cold work. As already mentioned segregation is one of the problems arising from the use of rimming steel. Table III shows the analyses at edge and centre of rimming steel at various positions down the ingot. It will be noted that in addition to the segregation produced by the rimming action there is segregation particularly of sulphur and phosphorus at the centre near the top of the ingot. Such variation in composition will obviously result in non-uniform properties throughout the length of a coil or batch of sheets. This can be tolerated to a limited

TABLE IV—*Interdependence of Mill Speed, Gauge, Finishing Temperature and Coiling Temperature*

Mill speed, ft. per min.	Gauge, in.	Finishing temperature, °F.	Coiling temperature, °F.
1810	0.140	1700	1400
1810	0.140	1630	1310
1750	0.140	1600	1290
1500	0.140	1700	1250
1500	0.140	1630	1200
1800	0.125	1650	1220
1700	0.125	1650	1190
1500	0.125	1650	1130
all normal speeds	0.100	all normal temps.	less than 1200

TABLE V—*Effect of Crystal Size on Mechanical Properties of Annealed Iron Strip*

Crystal size (number of crystals per sq. mm).	Limit of proportionality (tons per sq. in.)	Max. stress (tons per sq. in.)	Elongation per cent on 2 in.
Single crystal	2.0	10.0	33.0
6.3	2.89	15.03	35.25
15.3	2.77	16.33	47.0
51.0	4.5	17.37	44.75
75.5	8.98	18.73	47.0
120	7.44	18.40	42.5

extent but for very severe deep-drawing operations only the bottom half or at the most $\frac{2}{3}$ of the ingot can be used. One disadvantage of using $\frac{2}{3}$ of the ingot is that a short slab remains to be handled and this adversely affects production.

The grain size and structure depend upon the thermal and mechanical history of the steel. In the case of hot-rolled coil the grain-size and structure is determined by the finishing and coiling temperatures, as illustrated in Fig. 152. From this it will be seen that the optimum conditions of uniform equiaxed grain size with finely dispersed carbides are obtained by finishing above the upper critical temperature and coiling below 1250° F. (676° C.). If the finishing temperature is on the high side and coiling is carried out at temperatures above A_1, slow cooling of the coil results in a large uniform grain-size and the carbides are present in massive form. When the finishing temperature is below Ar_3 a low coiling temperature gives a mixed grain size, the grains near the surface being larger. A high coiling temperature, on the other hand, gives a mixed grain size with extremely coarse surface grains. Finishing near the Ar_1 range results in the ferrite grains being elongated. With a low coiling temperature this structure is retained, while with a high coiling temperature the self-annealing results in an extremely coarse grain-size.

Fig. 155 is a simplification of what actually takes place, for the structure is not uniform across and through the section of the strip since the temperature is not uniform in either direction, also the structure is affected by the segregation referred to above. Fig. 153([1]) shows schematically typical transverse cross-sections through the ends of hot-rolled coils with different finishing temperatures and with coiling temperatures below 1250° F. (676° C.)

In practice the coiling temperature is not independent of the finishing temperature since there is a limit to the amount of cooling that can be done between finishing rolling and coiling. The cooling rate also depends upon the mill speed and the gauge of the sheet. The interdependence of these factors is illustrated in Table IV. It must be emphasized that the temperatures quoted are surface temperatures, since these are what are recorded.

Table V([2]) shows the effect of grain-size on limit of proportionality, maximum stress and elongation of annealed iron strip. It will be noted that as the grain-size decreases there is an increase in all these three properties. However, this table only shows grain-size down to A.S.T.M.4, which is much coarser than is ever found in deep-drawing steels. Much more useful and relevant are the graphs in Fig. 154([3]) which show the effect of grain-size from A.S.T.M.4 to above A.S.T.M.9 on yield point and maximum stress.

Since a low yield and a high elongation are required a limit is set upon the fineness of grain.

TABLE VI—*Effect of Finishing and Coiling Temperatures on Mechanical Properties in Hot-Rolled Condition*
Deep-drawing Steel—0.09 per cent C., 0.41 per cent Mn.

Finishing temperature, °F.	Coiling temperature, °F.	Hardness, R_B	Yield stress, tons per sq. in.	Ultimate tensile stress, tons per sq. in.	Elongation per cent on 8 in.
Effect of Finishing Temperature					
1560	1010	64	18.25	24.0	30
1610	1080	61	16.75	23.15	30
1645	1180	57	14.0	21.1	34.5
Effect of Coiling Temperature					
1610	1080	61	16.75	23.15	30
1620	1200	58	16.63	23.9	31
1608	1280	54	15.30	22.15	32
1620	1370	51	13.00	19.95	34.5

Two other factors governing the optimum grain-size are its effect on the rate of ageing and on the surface appearance of the pressing. It has been shown that the finer the grain-size, the more rapidly will steel age. If the grain-size is too coarse, a pressing will show an undesirable rough surface as shown in Fig. 155. This defect is known as orange peel. An ideal grain-size is No. 6 on the A.S.T.M. scale, which is equivalent to 512 grains per square mm. More often in practice the grain-size is A.S.T.M.7, for a compromise must be made between the ideal conditions from a metallurgical point of view and the necessity of obtaining high outputs from the mill. Control of finishing temperature can be achieved by holding the partially rolled slab at the "delay" table between the 4th and 5th stand of the mill.

Control of coiling temperature within the reservations discussed above, is achieved by utilizing the correct number of banks of sprays on the run-out table. The coiling temperature can, of course, be controlled by altering the speed of rolling, but this would have an adverse effect on production.

Table VI shows the effect of finishing and coiling temperatures on the mechanical properties of D.D. sheet *ex* hot-rolled coil. It will be noted that the optimum properties are obtained with a finishing temperature in the region of Ar_3 and a coiling temperature slightly above Ar_1.

As already mentioned strip-mill products are normally rolled in one direction only and some directionality of properties is, therefore, to be expected due to preferred orientation of the crystal grains resulting in a higher yield stress and U.T.S. in the transverse direction. Normally, there is little effect on ductility. Inclusions are rolled out in one direction, and if the steel contains numerous stringer inclusions the transverse elongation differs markedly.

Hot-rolled E.D.D. sheets are used for a variety of purposes, particularly disc wheels, chassis frames and gas bottles. Normally, little trouble is experienced in pressing these, and causes for complaint arise, mainly from coarse grain giving a rough surface, or from inclusions or thumbnail lamination resulting in split pressings. For difficult jobs it is advisable to raise the coiling temperature so long as trouble with orange peel can be avoided, or is not important. Thus the coiling temperatures are by experience determined for each kind of job. This provides an example of the importance of records in the Routing Department.

The ideal degree of cold reduction from a metallurgical point of view is from 40 to 45 per cent, but the limits of the hot band gauge impose cold reductions up to 60 per cent and over occasionally. For example, the most common gauge of cold-reduced E.D.D. sheet is 20, *i.e.* 0.036 in. If a sheet is required to be 60 in. wide, as can be seen from Table VII, the hot band gauge must not exceed 0.0882 in. In this case the cold reduction required is just under 60 per cent. A greater degree of cold reduction is undesirable because of resulting fine grain-size, but is sometimes unavoidable.

After cold reduction the material is annealed either in coil form or after cutting into sheets. Annealing of the cold reduced sheet is carried out to remove the effects of previous cold work, to produce a suitably recrystallized grain-size and to obtain the carbides in a spheroidal form.

Annealing is carried out in an inert atmosphere to preserve the bright surface finish obtained in cold rolling and to prevent both decarburisation and carbon deposition. In coil annealing the inert gas is circulated around and through the charge, thus speeding up heat transfer and helping to obtain uniformity of temperature.

The grain-size and structure of the annealed sheet depend upon that of the hot-rolled band, the amount of cold reduction, the rate and temperature of heating and time of soaking during annealing. In general, the pattern of grain-size obtained in the hot-rolled band is reflected in the cold-reduced and annealed sheet. A mixed grain-size after hot rolling will give a similar mixed grain-size in the finished sheet and cold reduction does not obliterate the abnormally large grain-size obtained by wrong treatment in the hot mill. If the finishing and coiling temperatures have been so low as to produce a cold-worked structure, subsequent annealing of the cold-reduced coil will give an undesirably small grain-size. The greater the amount of cold reduction the lower will be the recrystallization

Fig. 156.—Carbide stringers in cold-reduced steel

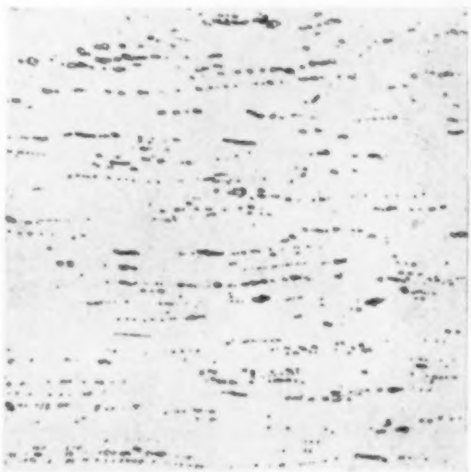
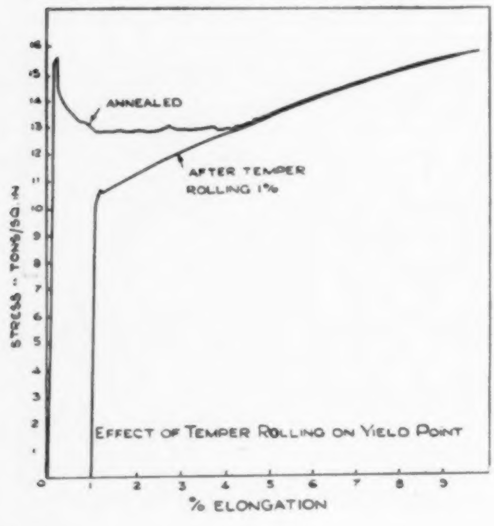


TABLE VII—*Gauges versus Maximum Widths*

Birmingham gauge (B.G.)	Thickness inches	Maximum width
11	0.1113	72 in.
12	0.0991	66 in.
13	0.0882	62 in.
14	0.0785	58 in.
15	0.0699	56 in.
16	0.0625	54 in.
17	0.0556	50 in.
18	0.0495	48 in.

temperature and the finer the grain-size. From the nature of the annealing operation, the heating rate is necessarily slow so that this factor is not of practical importance. Since the rate of heating is slow the annealing temperature does not in practice greatly affect the grain-size but it does affect the mechanical properties as, together with the annealing time, it determines the extent to which the carbide particles coalesce. The ideal structure consisting of a ferrite matrix in which spheroidal carbide is randomly distributed can only be obtained if the hot-rolled structure is of a similar nature, or is pearlitic. Massive cementite particles produced by finishing and coiling at a high temperature are broken up in cold reduction and form stringers during annealing (Fig. 156). These stringers result in inferior transverse mechanical properties. If the annealing temperature exceeds the Ac_1 point some carbide is dissolved and on cooling forms pearlite or massive cementite at the grain boundaries with consequent inferior mechanical properties. The ideal temperature is just below Ac_1, but at this temperature there is great danger of sticking between the laps of the coils.

Fig. 157.—Effect of temper rolling on yield point



A normal annealing cycle for extra-deep-drawing steel in coils is—heating during 24 to 30 hours to 1220 to 1240° F. (660 to 672° C.) soaking for twelve hours and slow cooling. Although in coil annealing furnaces the inert atmosphere is circulating around the coils, the topmost portion of the stack may reach the required temperature 10 to 15 hours before the bottom coils. Soaking time begins when the temperature at the bottom has reached 1180° F. (6380 C.) and the long soak is necessary to ensure a minimum gradient between top and bottom temperature, and reasonable uniformity of mechanical properties throughout the batch.

As with hot-rolled sheet, the ideal grain-size for cold-reduced annealed sheet is A.S.T.M.6. but since the degree of cold reduction in practice is usually over 50 per cent, the normal grain-size obtained is A.S.T.M.7. The annealing process is admittedly slow and cumbrous even when the material is in coil form; it is still slower in sheet form, but as discussed later it is sometimes necessary to anneal the material in the form of sheets. Continuous annealing has recently been applied successfully to tinplate coils and at some future date may be applied to auto-body sheet.

A new development in annealing is at present on trial in U.S.A. As previously described, in order to maintain shape in the cold mill, tension must be maintained between the coiling reel and the last stand, in consequence of which, the coil is a tight one; that is why it takes so long to bring the material up to the temperature in annealing. The new development consists of re-coiling in such a way that an open coil is obtained*, in consequence of which the speed of annealing is enormously increased, because the circulating gas passes between the coil turns. A higher temperature can also be used with much less danger of sticking between the wraps of the coil which is at present a not inconsiderable source of defective material.

The usual mechanical tests carried out on cold-reduced sheet are Rockwell hardness, tensile, and Olsen or Erichsen ductility tests. In the Olsen test a 1-in. diameter ball is pressed into the surface of the sheet sample; this is essentially a stretch-forming test. The result is expressed as the depth of cup formed in thousandths of an inch before fracture takes place. Typical mechanical properties of E.D.D. sheet after annealing are:—

Rockwell R_B	Yield point, tons per sq. in.	U.T.S., tons per sq. in.
45	15	20

Elongation on 8 in., (test piece ¾ in. wide)	Olsen,	Y.P. Elongation,
34 per cent	420	3 to 6 per cent

* See SHEET METAL INDUSTRIES, June, 1961, "Open-coil Annealing," by V. J. Gibbons.

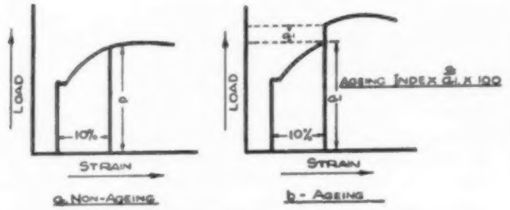


Fig. 158.—Method of obtaining ageing index

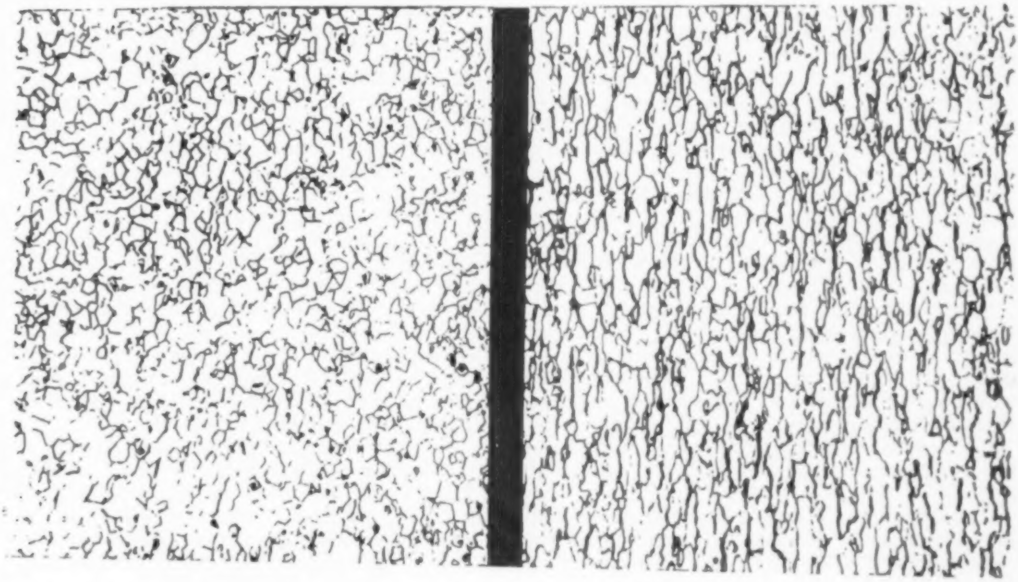
The Olsen figure refers to a 20-gauge sheet (0.036 in.). Thinner sheets will give lower and thicker sheets a higher value.

In the annealed condition the yield-point elongation results in formation of stretcher-strains when cold work is done within the region of the yield elongation. These stretcher-strain markings would still be visible after painting and accordingly are not permissible for any outside parts where appearance is of importance. The yield point elongation which causes this phenomenon can be removed by skin passing, that is, further cold reduction after annealing, usually from $\frac{3}{4}$ to 1 per cent. This skin passing has very little effect on all other mechanical properties but reduces the yield point to 10 to 12 tons per sq. in. (Fig. 157). Unfortunately, skin passing, being a form of cold work, is followed in time by ageing, with consequent return of the yield point elongation and increased hardening coupled with loss of ductility.

Although the yield-point elongation is removed by an extension of 158 per cent obtained by cold rolling, it can only be suppressed by tensile strain when the strain exceeds the yield-point elongation. Stretcher-strain markings are not formed during skin passing, but are formed during tensile straining. These markings may persist up to fracture, but after passing through the yield elongation zone, and releasing the stress, no more markings are produced by restraining. Fig. 158 shows the tensile stress/-strain characteristics of mild steel before and after straining 10 per cent. Curve *b* also shows the effect of ageing after straining 10 per cent. The increase in yield stress expressed as a percentage of the stress required to give 10 per cent elongation is known as the Gensamer Low Strain Ageing Index, and for ordinary rimming steels is of the order 16 to 20 per cent.

This phenomenon of ageing is a constant headache to steel suppliers and users alike, particularly in the summer months. It is not practicable to synchronize works and press-shops' schedules so as to arrange that pressing takes place within a few days of skin passing. Fortunately, a yield elongation of up to about $1\frac{1}{2}$ per cent can be removed by roller levelling so that if ageing has not gone beyond this stage roller levelling sheet at the press shops immediately before issuing to the presses prevents the formation of stretcher-strain but does result in slightly decreased ductility. The roller-levelling operation consists of flexing the sheet alternately in compression and tension, finally finishing with a flattened sheet. An apparent obvious solution of the

Fig. 159.—Equiaxed (left) and pancake (right) grains



ageing trouble would be to skin pass in the press shops but hitherto the cost and maintenance of the skin-passing equipment has ruled this out. A simple method would be storing sheets in press shops in a refrigerated store, but in this country at least, this has not yet been adopted.

When stretcher-strains are not objectionable, such as in floors and other "unseen" parts, material can be stored indefinitely without deterioration of properties provided it has not been cold worked after annealing. It is for this reason that annealing is sometimes carried out on sheets instead of coils, for uncoiling after annealing gives rise to coil breaks, (*i.e.* discontinuous yielding) which can be rectified only by skin passing.

At present the only satisfactory method of overcoming the problem of ageing is by using non-ageing steel known as stabilized steel, as already described. Such a steel, after skin passing, does not age at room temperature over several years. The full advantages of stabilized steel are obtained only if the hot sheet is coiled at a temperature not exceeding 1200° F. (648° C.) With this correct coiling temperature the final structure of the cold-reduced and annealed sheet shows elongated pancake grains, as illustrated in Fig. 159.

Stabilized steel with this structure, in addition to being non-ageing, has decidedly superior deep-drawing properties to those of rimming steel, of similar tensile properties.

A great deal of work has been published on the subject of ageing, but brief reference need only be made here to the practical aspects.

The present concept of the strain-ageing process is the diffusion of carbon and nitrogen atoms to dislocations at the onset of ageing causing an increase in the yield stress and yield point elongation, the ductility and ultimate tensile strength not being affected. In the later stages of ageing, carbon and nitrogen atoms, in excess of those required to anchor the dislocations, diffuse to and along them until they meet a barrier and there form a very small precipitate and this then affects the ductility and strain hardening capacity of the steel and possibly, as suggested by Tardif and Ball,([4]), in the latest stages, of the return of the yield point elongation.

The fact that the rate of ageing is doubled in summertime as opposed to winter, is one which does not receive the respect which it deserves in the press shops. Also it is a matter of considerable importance that the skin-passing operation on rimming steel takes place at room temperature after the coils have been hot rolled or annealed—a fact which similarly is not always given its due weight in the mill.

The rate of ageing is also affected by the amount of initial strain. When the initial strain is slight, the rise in yield stress and the return of the yield point elongation both occur very quickly, but the change in ductility and tensile strength is minor if existing at all. Larger amounts of pre-straining have the reverse effect, and little change in the yield stress and yield point elongation occur during the earlier stage of ageing, but after a long time the decrease in ductility and increase in tensile stress are greater than for lightly deformed material. Hence, commercially, we are betwixt the devil and the deep sea in that skin passing must be sufficiently heavy to prevent too rapid a return of the yield point elongation but not so great that a customer who keeps his sheets in stock for a long time, is too greatly inconvenienced by an excessive loss in ductility.

If the nitrogen is converted to a stable nitride with aluminium strain ageing at room temperature does not take place. As the temperature of ageing is raised Hundy has shown that ageing can cause a return of the yield stress due to the fact that at an elevated temperature carbon has an increased solubility in ferrite and therefore, starts to play its part. In fact, by raising the temperature of ageing of stabilized steel it can be made to go through an equivalent process to that which can be obtained experimentally in rimming steel at room temperature by increasing the nitrogen content from zero, *i.e.* strain ageing is firstly eliminated and then occurs at about 250° C. by affecting the yield stress and yield-point elongation only and finally by affecting the ductility.

The rate of ageing is affected by the grain-size in that the finer the grain-size the more rapid the change in properties over a period at constant temperature. This subject is one which has not been fully investigated and the evidence would seem to imply that the grain boundary plays a more important role in ageing than has been generally acknowledged. The grain-size is also related to sulphur content in low-carbon steels, an increase in sulphur content causing a decrease in grain-size given a standard state of processing conditions. There is also evidence that the rate of ageing is affected by the presence of solute atoms other than those responsible for anchoring dislocations, *e.g.* manganese, and there still seems to be scope for further useful work on the effect of the normal constituents of low-carbon steel on the rate of ageing.

Normally samples for mechanical tests are cut from the portion near the end of the coil after temper rolling. Additional tests are taken from time to time from sheets rejected for surface or gauge at the cut-up lines. Surface inspection is carried out at the cut-up lines and defective sheets are diverted to a separate pile. For very important jobs hand inspection is necessary. There are more than 50 possible surface defects to which sheets are liable; 25 of these are described and illustrated in the Iron

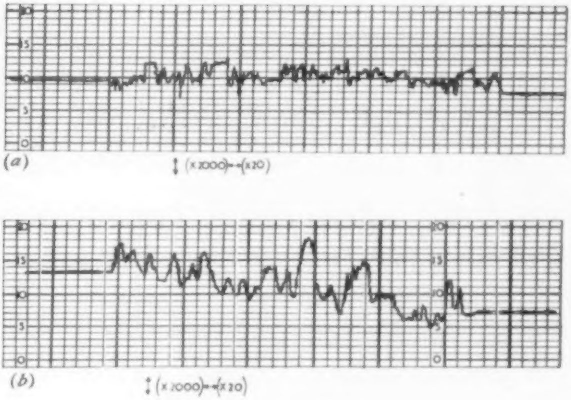
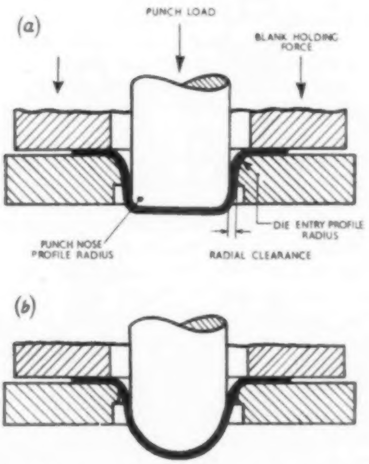


Fig. 160 (right).—Two typical Talysurf records (a) 29 microns (b) 60 microns

Fig. 161.—(a) Flat-based cup (b) Hemispherical-based cup



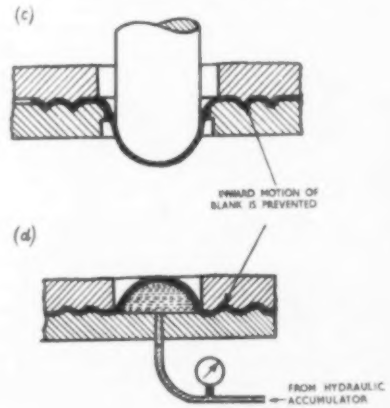
and Steel Institute's Special Report No. 63, already referred to. Some customers have particular requirements regarding the surface roughness of the sheet. This is controlled by the shotblasting of the work rolls in the cold mill and the temper mill.

To reduce the incidence of stickers it is advisable to have a reasonably rough surface (50 C.L.A.) in the cold mill, and to produce a finer surface, if required, in the temper mill. Various types of profileometers are on the market, and these record at a very high magnification the roughness of the sheet. The instrument automatically integrates the results and this is recorded as a centre line average (C.L.A.). Fig. 160 shows two typical records obtained on the Talysurf machine. Normal finish has a centre-line average of 40 microns. For certain jobs such as chromium plating, a very slick finish is required.

At present the only true guide to the desirable mechanical properties of E.D.D. steels are the usual mechanical tests already referred to. These, however, do not correlate altogether satisfactorily with press performance. This is doubtless, at least in part, because press shop operations are usually a combination of stretch forming, as illustrated in Fig. 162, and deep drawing, as illustrated in Fig. 161.

Work on this problem was initiated more than 20 years ago in the Engineering Department at Sheffield University, and arising from this work the Swift Cupping Press was designed, both to simulate the actual pressing operation, and to obtain more quantitative data on what actually happens under the press. It was soon established that to obtain reproducible and reliable results, every detail of the machine and its operation required to be standardized. Dimensions of all operating parts and of the test piece—surface condition of die and punch—punch and die radii, holding pressure, nature of

Fig. 162.—(c) Stretch-forming by hemispherical punch (d) Stretch-forming by bulge test



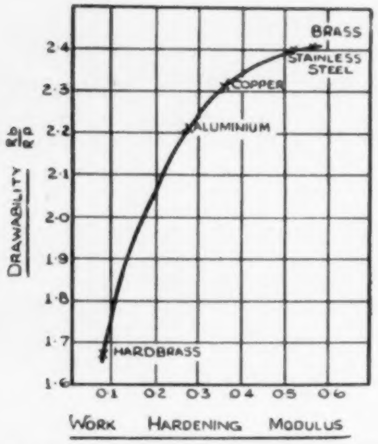


Fig. 163.—Correlation between work-hardening modulus and drawability

lubricant, and where applied—all are of vital importance. In testing, the punch diameter is 2 in. and different size blanks are used.

The criterion of drawability is the highest ratio of the initial blank diameter to the punch diameter at which failure does not take place. This ratio depends not only upon mechanical properties of the steel but also upon the thickness. The thicker the material the greater will be the drawing ratio.

Some peculiar anomalies were disclosed in comparing the results of flat-bottomed with round-headed punches. These were summarized as follows by Professor Swift in a paper read to the British Association in 1954([5]) :—

(1) Metal in a soft condition draws somewhat better over a round-headed punch (Fig. 161) than over one with a flat head ;

(2) Metal in a relatively hard condition draws much better over a flat-headed punch (Fig. 161).

(3) With a round-headed punch the drawability of a good metal is considerably impaired by prior hardening ;

(4) With a flat-headed punch, the initial condition of the metal has relatively little effect.

It is not surprising, therefore, that success or failure in the press shop depends not only upon the surface condition, mechanical properties, and uniformity of gauge of the steel, but also upon the press tools and their operation. The importance of these is all the greater because most jobs are assymetrical and no-one—least of all the designer of the car body, knows which part of the pressing will be deep-drawn and which stretch-formed.

Before a press run of a new part, which may comprise several thousand sheets, gets under way, trials are run while the punch and dies are set and re-set and lubricant grease is splashed here and there to assist in metal flow as required. Finally, when the trial run is satisfactory production begins and goes on smoothly if the whole batch of material is uniform in mechanical properties, gauge and surface condition. If splits arise from obvious surface defects nothing can be done about it ; otherwise more lubrication or an increase in die-punch clearance may be the cure, but these adjustments are, of course, carried out at the expense of production. If the clearance exceeds a certain amount, buckling or wrinkling takes place, and, of course, there is a limit to which this can be tolerated.

Other criteria which have been considered for determining drawability of steels include—

(1) *Plastic Anistropy*—A relationship has been found between press performance and the ratio of width strain to thickness strain in a tensile test, a high ratio indicating good press performance.

(2) *Work-Hardening Modulus—i.e.* "n" in the equation $Y = kx^n$, where $Y \times$ true stress, $x =$ true strain, and $k =$ a constant. The higher the value of "n", the better is the drawability of the steel.

As Fig. 163 ([6]) indicates, this relationship applies to metals generally.

These two methods have the advantage that they deal with measurable mechanical properties, and for this reason they are particularly worthy of further investigation. There still remains the practical problem of how to control economically either plastic anisotropy or the work-hardening modulus.

References

1. Bird, R., Private Communication.
2. Edwards, C. A., and Pfeil, L.B., *J.I.S.I.*, 1925, **112** (II), p. 95.
3. Andrew and Lee, *J.I.S.I.*, 1942, *CXLV*, p. 179.
4. Tardif, H. P., and Ball, C. S., *J.I.S.I.*, 1954, **182**, pp. 9-19.
5. Swift, H. W., *Sheet Metal Industries*, 1954, October, p. 817.
6. Arbel, C., *Sheet Metal Industries*, 1950, November-December, p. 926.

New Alloy Steel

SAMUEL FOX and Co. Ltd. have started commercial production of a new alloy steel designed for service temperatures up to 675°C. Known as Esshete 1250, this is an austenitic creep-resisting steel containing 15 per cent chromium, 10 per cent nickel, 6 per cent manganese, the composition including smaller percentages of silicon, molybdenum, vanadium, niobium and boron.

Esshete 1250 has proved satisfactory in the production of bars, tubes, pipes and large forgings; sheet trials are in progress.

INSTITUTE OF SHEET METAL ENGINEERING

Recent and Forthcoming Events

1961 AUTUMN CONFERENCE AND EXHIBITION TO BE HELD IN BIRMINGHAM

THE 1961 Autumn Conference of the Institute, together with the Exhibition of Sheet Metal Working Equipment and Techniques will be held at the Imperial Hotel, Birmingham on November 7-9, returning to the Midlands for the first time since 1952.

The Conference opens on the morning of November 7, with the formal opening of the Exhibition and the first technical session follows in the afternoon. The whole of the second day is to be devoted to discussing papers on "Problems Inherent in Feeding in Modern High-Speed Presswork Production". Papers in the third technical session on the morning of November 9 will be devoted to the theme "Feeding, Slitting and Processing of Heavy Coils in Rolling Mills, Press Shops and Warehouses". The fourth and final session in the afternoon will be related to the properties of metals when deformed at high rates of strain.

The detailed programme of this Conference will be issued at a later date but in view of the shortage of hotel accommodation in Birmingham, members and others intending to attend the Conference are advised to reserve their requirements well in advance.

RESULTS OF PRIZE ESSAY COMPETITION

The Prize Essay Competition announced by the Education Committee of the Institute evoked an encouraging response from Technical Colleges and apprentice schools throughout the country. The competition was restricted to entrants between the ages of 20 and 25 and a first prize of £25 was offered for an essay on any aspect of sheet metal technology, including some reference to the practical use of sheet metal.

The panel appointed by the Education Committee to assess the entries, reported a very wide variation in approach and standard, and was not able to recommend the award of the first prize to any single entry. Two entries were adjudged equal in second place, receiving prizes of £10 each and two other entries were commended, receiving prizes of technical books.

The prize winners were present as guests of the Institute at the Luncheon at the Connaught Rooms on May 18 last and received their prizes from the President of the Institute, Mr. E. W. Hancock, O.B.E.

The authors of the winning entries were as follows:

Second Prize £10 each to

Albert Wright, Ritherdon and Co. Ltd.

Rodney Dewsbury, Pressed Steel Co. Ltd.

Commended, book prizes to

Frank Ashton, Schweppes Mineral Waters Ltd.

Frederick Fearon, Grayson Rollo and Clover Docks Ltd.

Details of the next competition will be announced next September.

PROGRESS AT SPENCER WORKS

General view of progress at R.T.B.'s Spencer Works. The hot- and cold-mill buildings and despatch bay can be seen behind the cooling towers.

FOR OUR OVERSEAS READERS

(Continued from page 479)

Résumés des Principaux Articles

nologie du Travail à la Presse et de l'Emboutissage Profond". Il s'en tient aux presses mécaniques, et traite de sujets tels que les variations de pression résultant de l'augmentation de l'effort mécanique provenant de l'approche de la manivelle du point mort inférieur; des engrenages; du régime en charge de la presse; de l'energie et de la puissance; de l'energie du volant nécessaire; des embreyages et des freins; des bâtis de presse; du rôle des tirants; des glissières; des guides glissières et du réglage des glissières; des amortisseurs; de la lubrification, etc., etc.

Procédés d'Assemblage des Carosseries de la Consul Classic 315 .. page 515

La Consul Classic 315 est la dernière nouveauté annoncée par la Ford Motor Co. Ltd. de Dagenham. Cet article illustré décrit d'une manière générale la suite des operations d'assemblage des carosseries et donne des renseignements détaillés au sujet du materiel de soudage multiple, y compris l'appareil Electro-Mechan de chauffage à deux phases, installé pour le soudage des parties inferieures de la caisse.

Introduction à la Théorie et la Pratique du Laminage à Plat.—10 .. .. page 528

Par C. W. Starling, B.Eng., A.M.I.Mech.E.

Ce dernier chapitre du livre du regretté auteur (devant paraitre sous peu à la University of London Press) traite des "Considérations Métallurgiques" dans le procédé du laminage.

Zusammenfassungen der Hauptartikel

mechanische Pressen und behandelt u.a. die Druckschwankung auf Grund der Kraftvergrößerung bei Annäherung der Kurbel an den unteren Totpunkt, Getriebe, Pressenbemessung, Arbeitsvermögen und Leistung, benötigte Schwungradenergie, Kupplungen und Bremsen, Pressengestell, Arbeitsweise des Gestänges, Stößel, Stößelführungen und Stößeleinstellung, Puffer, Schmierung.

Verfahren bei der Zusammensetzung der Karosserie des Consul Classic 315 Seite 515

Der neueste, von der Ford Motor Co. Ltd. zu verlautbarende Kraftwagen, ist der Consul Classic 315. Dieser illustrierte Aufsatz beschreibt im allgemeinen die Folge der Zusammenstellungsvorgänge an der Karosserie und erklärt in allen Einzelheiten die Mehrfach-Schweißausrüstung, einschließlich der zweistufigen Electro Mechan-Heat (Elektro-mechanischer Schweiß-) Maschine zur Verschweißung des Chassis.

Einleitung in die Theorie und Praxis des Flachwalzens—10 Seite 528

Von verstorbenen C. W. Starling, B.Eng., A.M.I.Mech.E.

Dieses letzte Kapital aus dem Buch des verstorbenen Verfassers (das bald als Herausgabe der University of London Press erscheinen wird), behandelt „Metallurgische Überlegungen" des Walzvorgangs.

Résumenes de los Artículos Principales

"La tecnología del estampado profundo y del prensado" en la Escuela de Tecnología de Wolverhampton y Staffordshire. Limita sus observaciones a las prensas dotadas de fuerza motriz mecánica y trata de caracteristicas tales como la variación de presión al aumento de ventaja mecánica al irse acercando la cigüeña al punto muerto inferior, de los engranajes, clasificación de prensa, energía y potencia, energía de volante necesaria, embragues y frenos, bastidores de prensa, función de los tirantes, correderas, guías de corredera y ajuste de corredera, almohadillas, lubricación, etc., etc.

Procedimientos para el montaje de la carrocería del Consul Classic 315 página 515

El más reciente modelo de automóvil anunciado por la Ford Motor Co. Ltd., de Dagenham, Inglaterra, es el Consul Classic 315. Este articulo ilustrado describe, de forma general, el programa de montaje de la carrocería y da información detallada sobre el equipo de soldaduras múltiples incluso la máquina "Electro Mechan-Heat" de dos fases que se ha instalado para la soldadura de la parte inferior de la carrocería.

Introduccia ón la teoría y la práctica de la laminación plana—10 .. página 528

Por C. W. Starling, B.Eng., A.M.I.Mech.E.

Este, el último capitulo del libro del difunto autor (que la University of London Press va a publicar en un próximo futuro), trata de "Consideraciones Metalúrgicas" en el procedimiento de laminación.

Body Assembly on the Consul Classic 315

(*Continued from page* 527)

Acknowledgements

Acknowledgement is made to the directors of the Ford Motor Co. Ltd., for permission to publish this article and to many members of the company's staff for their assistance in its preparation.

G.T.M.A. HANDBOOK

The eighth edition of the new G.T.M.A. Handbook and Buyers' Guide index is now published and is available from the Association at Standbrook House, 2/5, Old Bond St., London, W.1. In addition to full details of member-companies, names and addresses, etc., of the B.P.P.M.A. are included.

SHEET METAL NEWS

FEATURING EVENTS AND PERSONALITIES IN THE INDUSTRY

CO-OPERATIVE RESEARCH PROJECT

New laboratories opened by Metal Containers Ltd. and Inland Steel Container Co.

A UNIQUE co-operative enterprise began operations recently with the official opening of the jointly operated Passfield Research Laboratories of Metal Containers Ltd. and the Inland Steel Container Company of the U.S.A. Metal Containers Ltd. and its subsidiary and associated companies are a major producer of steel drums in the U.K., of fibre drums, plastic containers, stainless-steel barrels and accessories. This group operates six factories in the U.K. The Inland Steel Container Company operates five container plants in the U.S.A. and is among the largest American steel container and drum manufacturers. Both companies basically operate in the same field. Their products are manufactured on highly mechanized high-speed lines and are sold almost exclusively to industry, among others to the oil industry, the chemical industry in its widest sense, the paint industry, foodstuff industry, etc.

The Metal Containers' Group is part of the International Van Leer Group, which originated and still has its headquarters in Holland. Van Leer's have some forty factories in Europe, North, West, South and East Africa, Australia, Asia, South and Central America. Its products comprise steel containers in a wide variety of types and sizes, liquid gas bottles for butane and propane, etc., steel and plastic storage tanks, stainless-steel barrels for the brewing trade, fibre-board drums, plastic containers, tinplate containers, drum closures and accessories. It is also engaged in steel merchandising and manufacture of industrial gases in some countries.

The Inland Steel Container Company is a division of the Inland Steel Company with headquarters at Chicago. Inland Steel is among the larger fully integrated American steel producers with an ingot capacity of 6½ million tons. Apart from its iron ore mining and limestone quarrying, it has nation-wide steel merchandising operations and in addition to its container division owns a large number of factories making such products as steel roof decks, cellular steel floors, steel wall panels, metal buildings, windows, conductor pipes etc., etc.

Both groups have therefore similar operations in the container field, coupled with an absence of conflicting interests—Inland being principally based in the U.S.A. and Van Leer world-wide based outside the U.S.A. No financial ties are in existence other than the joint ownership of an engineering company in the U.S.A., previously wholly owned by Van Leer. This company manufactures specialized equipment for the container, automotive, aircraft and other industries.

The common interests of the two groups has led to an agreement for the exchange of "know-how" and joint development of processes and products in the container field. Identical trends and developments in the steel container trade in the U.S.A. and Britain, with diversifications into alternative and "additive" materials furthermore set problems which can only successfully be approached by a research establishment specifically set up for this purpose.

The laboratory block comprises Physics—Analytical Chemistry—Organic Chemistry and Physical Chemistry Laboratories. Expansion to four times its present size and pattern is possible—whereas land for further expansion is available.

The research programme covers a wide field of subjects initially directed to improvements to containers and the development of new packages, research into such subjects as properties of steel surfaces and improvements thereto, the adhesion of coating films—into the field of polymers and co-polymers, fibre materials, adhesives etc., are expected to lead to improved containers in steel, plastic and fibre materials and new steel/plastic and fibre/plastic packaging systems and the manufacture thereof.

A steering committee of directors and executives of both companies, meeting at regular intervals, decides on research projects and budgets, evaluates results, technical applications and commercial potentials. Day-to-day management is by Metal Containers Ltd.

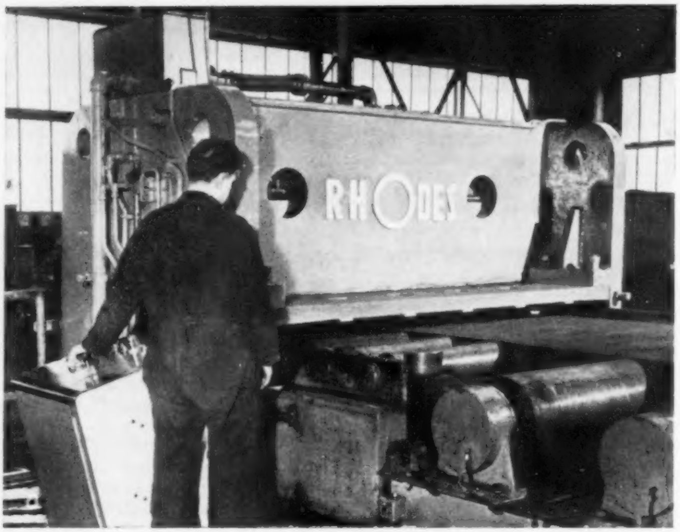
The new Passfield Laboratories of Metal Containers Ltd. and the Inland Steel Container Co.

UP-CUTTING SHEARS FOR STAINLESS STEEL

A MODERN up-cutting shears incorporating their patented "Fluid Drive" principle has been supplied by Joseph Rhodes and Sons Ltd., Wakefield, to the Stocksbridge Works of Samuel Fox and Co. Ltd. The shears was designed specially for inclusion at the end of a "cut-to-length" automatic line, and is capable of shearing up to a maximum thickness of 1 in. of mild steel or ¾ in. of stainless, to maximum width of 6 ft. 6 in. The cutting rate of the shears on plate up to ⅜ in. thick is 20 strokes per min. and on thicker plate 6 strokes per min.

In the fluid-drive method of actuation, an electro-hydraulic source of power is used to actuate the mechanical action of the shears. The hydraulic power provides an easily regulated and controlled motive force, while the mechanical action ensures high speeds with precision of movement. There are no clutches, rotating shafts, gears, flywheels; the fluid drive limits the load which can be put upon the machine, and eliminates any ill effects due to accidental overload. The relief valve in the hydraulic circuit ensures full safety against overload, as should any overload occur the beam would immediately return to its top of stroke position.

Being of the up-cutting type, the shears allows the line conveyor to be maintained at a fixed height, a great advantage over the orthodox down-cutting shears which would necessitate an automatic dipping conveyor on the outgoing side of the line.



Cutting stainless steel with up-cut shears.

HEAT TREATMENT PLANT FOR SCOTLAND

BRITISH FURNACES LTD., Derby Road, Chesterfield, have recently received orders for gas carburizing equipment to be installed in the works of one of a leading commercial vehicle manufacturers in Scotland.

The orders for the Scotstoun factory of Albion Motors Ltd., cover four super Allcase sealed quench furnaces, complete with fully automatic sequence control, together with the necessary dew point controlled "RX" endothermic atmosphere generating plant, and other ancillary equipment, such as tempering furnace, power operated charging machine, etc. This plant will provide completely up-to-date final heat treatment for their transmission gears.

UNITED STEEL TO DEVELOP AIRSTRIP NEAR SHEFFIELD

THE United Steel Companies Ltd. have purchased 108 acres of land near Coal Aston, ten miles to the south of Sheffield, for development as an airstrip for use by the company's aircraft. Town Planning approval has been given to this project and work is now proceeding on the preparation of an 800-yard long grass runway.

When completed, it will enable customers and senior executives to reach United Steel's head office in fifteen minutes by car, with about half-an-hour's travelling to the company's steelmaking branches in the Sheffield area.

United Steel purchased their first executive aircraft—a four-seater Piper Apache—in July, 1958. Having established the value of this means of transport for conveying customers and senior executives between the company's principal branches in Sheffield, Scunthorpe and Workington and to other parts of the country, a Piaggio P166 was obtained last summer. This aircraft is twin-engined, like the Apache, and can carry a pilot and five passengers, having a range of 1,000 miles without refuelling. Both aircraft and their two full-time pilots are at present based at Ringway Airport, Manchester.

TEMPERED GROUP LTD. ACQUIRE HENRY ROSSELL AND SON LTD.

TEMPERED GROUP LTD., Sheffield, have acquired the entire issued share capital of Henry Rossell and Son Ltd., Effingham Street, Sheffield, 4.

The new board of Rossell's will comprise Mr. Gerard Young, J.P., Mr. Hugh Young, B.Sc., and Mr. C. Graham Murray, M.B.E. Mr. K. G. Settle, A.A.C.C.A., will continue as Secretary.

Rossell's principal products are engineer's small tools, circular cutters and machine knives; to some extent they are complementary to those produced by Alfred Beckett and Sons Ltd., another old-established Sheffield firm which joined Tempered Group in 1959. It is intended that each firm's business shall be developed in its own specialist field.

CHANGES OF ADDRESS

ELECTRONIC SWITCHGEAR (LONDON) LTD. have now moved to Wilbury Way, Hitchin, Hertfordshire. Tel: Hitchin 3646 (3 lines).

* * *

The London office of C. C. COOPER LTD. has now moved to 19 Queen Street, Mayfair, London, W.1. Tel: GROsvenor 2518. Telex No: London 23369. Cables: Alletrab London.

GERMANIUM

JOHNSON, MATTHEY AND CO. LTD., 73-83 Hatton Garden, London, E.C.1, announce important developments in connexion with their work on germanium. Zone-refined (50Ω-cm, *n*-type) germanium is now available, normally in ingots having a nominal weight of 1 kg. A large scrap-recovery plant has been installed which enables a wide variety of types of germanium-bearing residue to be processed. The company now wishes to purchase large or small quantities of germanium scrap, and will be pleased to hear from any organisation having such material for disposal.

SCHOOL OF WELDING TECHNOLOGY

A NEW prospectus has been issued by the Institute of Welding in which details are given of courses to be held in October, and the future programme between November, 1961, and March, 1962, is also included.

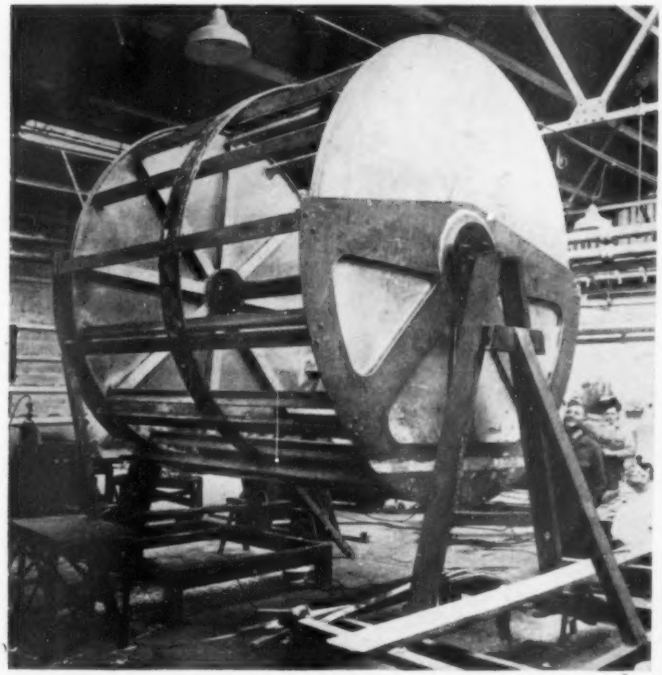
The School of Welding Technology established by the Institute of Welding in 1957 is a venture in co-operative education which makes available to the engineering industry of Great Britain a fund of technical information and managerial experience about all the factors upon which the satisfactory and efficient application of welding depends. Full-time lecture courses, which may last up to one week or more, are held in London at the headquarters of the Institute, and evening courses are held in London and in appropriate industrial centres. In general the courses are for engineers, designers, metallurgists and managerial and supervisory staff—in all cases for men who have received an engineering training. They provide the latest information on design, manufacture, inspection and research. The lecturers are leading experts from industry, the universities and research associations.

Full details are available from the Institute at 54 Princes Gate, Exhibition Road, London, S.W.7.

ROTARY COOLANT FILTER UNIT FILTERS 830 GALLONS A MINUTE

A ROTARY coolant filter of unique design has been developed for use with the new 72-in. cold mill which is now being installed by James Booth Aluminium Ltd. at their Kitts Green works, Birmingham. The filter unit, which is believed to be the largest aluminium structure of its type, is designed to keep the mill coolant uniformly clean, so that the rolled products have an exceptional high-quality finish.

The unit, designed by The Loewy Engineering Co. Ltd. (Bournemouth) in conjunction with James Booth's project engineers, was fabricated by Windshields of Worcester Ltd. (St. John's Works, Worcester). It measures 12 ft. high, over 20 ft. long and 10 ft. wide, and contains 8,000 gallons of paraffin coolant, the filtration equipment itself, and two 830 gal. per min. capacity coolant circulating pumps.



AEI WOOLWICH GROUP DISTRICT OFFICE ORGANIZATION FOR KENT AREA

ASSOCIATED Electrical Industries' Woolwich Group branch office at Maidstone has ceased to operate. Its activities are now undertaken by the Woolwich Group branch office at 33 St. Dunstans Street, Canterbury (Tel: Canterbury 5332-5). Canterbury Branch, which already handles the products of AEI Cable Division, is now also distributing AEI Radio and Electronic Components Division products, and will cover the whole of the Kent area.

The branch remains under the management of Mr. W. R. Morley. Mr. R. V. Banks, who has been managing Maidstone branch, will remain in the Maidstone district to supervise sales promotion in the Kent area. His address is 9 Market Buildings, Maidstone (Tel: Maidstone 55571).

AGENCY

P.M.T. (MACHINE TOOLS) LTD., Oozells Street, Birmingham 1, have been appointed sole selling agents for the Mullard Autoplot and Automatic Co-ordinate Positioning machines designed for automatic marking out in sheet metal and similar work by electronic numerical control. A demonstration machine is available at the company's Birmingham showrooms.

P.M.T. have also been appointed exclusive distributors for S.A.I.M.P. of Italy, manufacturers of precision lathes and milling machines. A comprehensive stock of lathes and milling machines, vertical, universal and turret type, can be seen at their Birmingham showrooms.

APPOINTMENTS and STAFF CHANGES

It is announced by **Ferro Enamels Ltd.** of Wombourn, Wolverhampton, that Mr. C. Vickers, A.M.I.E.E., A.M.I.Mech.E., has been appointed general sales manager.

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Thos. P. Headland Ltd., have increased their sales force by the appointment of two additional representatives in Essex and the London postal districts North and East. Mr. B. G. Barnes will cover this area specializing in machine tools and machine-tool accessories and Mr. T. Cusselle will cover the same area specializing in all types of gas and electric welding equipment.

* * *

Major F. D. Outridge, R.A. (Retd.), F.C.C.S., has been appointed assistant to Capt. R. A. Villiers, C.B.E., director of the **Scientific Instrument Manufacturers' Association,** 20 Queen Anne Street, London, W.1.

* * *

Mr. W. E. Hughes has been appointed director and general manager of **British Industrial Gases Ltd.,** Enfield. He succeeds Mr. F. Blackmore who is now manager of Equipment Development, Technical Division, The British Oxygen Co. Ltd.

Mr. Hughes is succeeded as sales manager by Mr. L. H. Pierson, formerly field manager, who has been with B.I.G. for 31 years.

* * *

Mr. Raymond V. Ely, M.I.E.E., M.I.Mech.E., a specialist in the field of the application of electrical transformers to arc welding and X-ray technology, has been appointed consultant to **Gresham Transformers Ltd.,** Gresham House, Twickenham Road, Hanworth, Middlesex.

* * *

Mr. H. G. Hinckley has been appointed manager of the machine-tool control department of **Ferranti Ltd.,** Edinburgh.

He replaces Mr. D. T. N. Williamson, manager of the department since its inception in 1952, who has left to become director of research and development at Molins Machine Company Ltd., in London.

Mr. G. C. Richardson has been appointed export manager, Overseas Division, **The British Oxygen Co. Ltd.** This is a new appointment and has been made to strengthen B.O.C.'s extensive overseas sales activities.

* * *

Mr. John Blinch has given up his appointment as director and secretary of the **Purchasing Officers' Association,** and in future the appointments of director and secretary will be held separately.

Mr. Peter Emery, M.A., M.P., has been appointed director, and the secretary will be Mr. H. Hughes, A.C.I.S. Mr. Hughes has been with the Association since 1948 holding the appointments of assistant secretary and administrative secretary.

* * *

Associated Electrical Industries Ltd. announce the following staff appointments:

Mr. Norman Elce, M.Sc.Tech., M.I.Mech.E., F.R.S.A., director and chief mechanical engineer, Associated Electrical Industries (Manchester) Ltd., has retired after 41 years with the AEI group of companies. He has been appointed consultant to the managing director at Manchester.

Mr. R. F. Marshall has been appointed central education manager and Mr. D. Baird central personnel manager.

Mr. G. F. Gribbin, B.Sc., A.M.I.E.E., has been made sales manager of its X-ray department.

Mr. R. S. Gilling, B.Sc., A.M.I.E.E., A.M.I.W.M., is now manager of the military and marine radar works at Blackbird Road, Leicester.

* * *

The United Steel Companies Ltd., announce the following appointments:

At **Steel, Peech and Tozer** Mr. C. H. Hayter at present works manager (Templeborough), will be works manager (Ickles departments and bar mills); Mr. R. Scholey, works manager (Ickles), to works manager (flat products); Mr. R. S. Howes, manager of the *Spear* project, to works manager (steel-making and primary mills); Mr. P. Beynon, at present works manager (operational research and work study), is personnel manager; Dr. B. B. Hundy, chief research metallurgist, to chief metallurgist; Mr. W. Ash, at present chief works metallurgist, will be deputy chief metallurgist; Mr. H. A. Longden, assistant chief works metallurgist, is to be works metallurgist, and Mr. M. Thomas, works manager (services), will be general services manager.

At **Appleby-Frodingham Steel Co.,** Mr. E. A. Atkin, formerly assistant chief engineer, is now deputy chief engineer.

At **Workington Iron and Steel Co. Ltd.,** Mr. E. L. Morgan, formerly works metallurgist, has been appointed chief metallurgist, and Mr. A. G. Hock, formerly research manager, has been appointed metallurgical consultant.

Mr. E. T. Sara has been appointed assistant general sales manager of **The United Steel Companies Ltd.** He will be responsible for the district sales offices in the United Kingdom, as well as for the commercial research, public relations and publicity departments.

Mr. W. E. Bardgett, research manager in the research and development department of **The United Steel Companies Ltd.,** has retired but will remain with the department as a consultant. Dr. K. J. Irvine, at present deputy research manager, succeeds Mr. Bardgett with the title of metallurgical research manager.

* * *

Mr. J. H. Raynor and Mr. J. R. Thompson have recently joined **Rockwell Machine Tool Co. Ltd.,** as machine tool sales engineers, operating in the Midlands area from the Birmingham office.

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Mr. K. H. Baker and Mr. A. J. Smyth-Tyrrell have joined the board of **Baxter, Fell and Co. Ltd.**

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Mr. C. E. Wrangham has retired from the boards of **Davy-Ashmore Ltd.** and its subsidiaries.

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The appointments are announced of three new directors to the board of **Brookhirst Igranic,** a company in the Metal Industries Group. They are Mr. N. Clark, company secretary, Mr. H. Rothwell, chief development engineer, who becomes works director, and Mr. A. E. Williams, chief application engineer, who becomes chief engineer.

* * *

The following appointments have been made to the board of the **Consolidated Pneumatic Tool Co. Ltd.:** S. H. Ireland (assistant managing director), L. S. Bright (financial director), A. O. Miller (director).

Appointments and Staff Changes

(*Continued from page* 544)

The appointment is announced of two new directors of **I.C.I. Metals Division,** Mr. T. H. Gallie (Overseas) and Mr. J. R. H. Crane (Copper Products).

Mr. Gallie has been concerned with metal sales throughout his 25 years' service with the company and for the past two years has been metal sales manager, Midland region.

Mr. Crane joined I.C.I. Metals Division as a laboratory assistant in 1939 but quickly developed a bent for the technical side of metal production.

* * *

Mr. R. T. Miller has been appointed managing director, and Mr. A. George assistant managing director of **Fletcher Miller Ltd.,** a member of the Castrol Group of Companies.

Both Mr. Miller and Mr. George are directors of Castrol Industrial Ltd., another member of the Group.

* * *

Mr. G. M. Hayward, M.I.Prod.E., technical director of **F. J. Edwards Ltd.,** London, has been appointed joint managing director of **Chard Machinery Manufacturing Co. Ltd.,** Chard, their subsidiary company, who manufacture the well-known range of "Besco" sheet metal working machines.

* * *

Keith Blackman Ltd., manufacturers of the "Tornado" range of fan engineering and industrial gas equipment, announce that Mr. D. S. Woodley, M.I.Mech.E., M.I.H.V.E., while remaining as chairman and consultant to the company, has retired.

Mr. F. W. Goodge, a joint assistant managing director, has been appointed to succeed as managing director and Mr. C. J. Atkins is now assistant managing director.

* * *

Mr. E. B. Bishop has been appointed secretary of **Metal Cleaning Ltd.,** a member of the Castrol Group of Companies. He succeeds G. J. B. Williams who is now to concentrate on this company's reorganization and sales development. Both Mr. Bishop and Mr. Williams are directors of the company.

* * *

Owing to ill-health Mr. W. Stringer-Jones, D.F.C., has resigned his chairmanship and managing directorship of **Jones and Attwood Ltd.**, of Stourbridge, and the company has been acquired by The Mining Engineering Co. Ltd. of Worcester.

Mr. Bernard Higgins, joint managing director of The Mining Engineering Co. Ltd. becomes in addition chairman and managing director of Jones and Attwood Ltd. Mr. G. W. Stanbury, Mr. W. E. Hand and Mr. P. N. Hood remain on the board of the latter company.

* * *

The Press and Shear Machinery Co. Ltd. of 172-178 Victoria Road, Acton, London, W.3, have appointed Mr. H. Baldwin Midlands area representative. He can be contacted at 1075 Kingsbury Road, Erdington, Birmingham, 24 (Tel: Castle Bromwich 3781-2).

* * *

Mr. T. S. Jones, of **Crompton Parkinson Ltd.,** has been elected president of the Electric Light Fittings Association for 1961, having served continuously on various committees of the Association since 1942.

In taking over his new position, Mr. Jones relinquishes the chairmanship of the Industrial and Commercial sections but retains the chairmanship of the recently formed Import/Export committee.

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The Elgar Machine Tool Co. Ltd., have appointed Mr. J. A. Perkins a director.

Mr. J. G. Fahey has resigned his directorship and left the service of the company.

* * *

Mr. H. E. Cox, M.I.E.E., has been appointed director of manufacture **Associated Electrical Industries (Rugby) Ltd.,** following the recent retirement of Mr. H. L. Satchell, M.B.E., F.I.W.M.

Mr. Cox was appointed manager of the Rugby works in 1955, and general manager in 1957. He joined the board of **BTH** (now AEI (Rugby) Ltd.) in 1958, and was appointed deputy director of manufacture in January 1960.

* * *

The Rt. Hon. Lord Clitheroe, P.C., has been appointed a vice-chairman of **Tube Investments Ltd.**

Sir Ben Lockspeiser, K.C.B., F.R.S., and Sir Francis de Guingand, K.B.E., C.B., D.S.O., have resigned from the board.

Dr. J. M. Kay, M.A., Ph.D., at present Professor of Nuclear Power at the Imperial College of Science and Technology at the University of London, has been appointed to the board of Tube Investments Ltd. as director of research and development.

* * *

Mr. T. Richmond has been appointed to the board of the **Titanic Steel Co. Ltd.,** a subsidiary of Samuel Osborn and Co. Ltd.

Alcan Industries Ltd. announce the election of two new directors Mr. A. A. Bruneau and Mr. R. J. Moyse.

Mr. Moyse, who was appointed chief financial officer and treasurer of the company last year, joined the Aluminium Ltd. organization in 1951, serving with Aluminium Securities, Montreal, and latterly as secretary-treasurer of the Indian Aluminium Co. Ltd.

Mr. Bruneau joined Alcan Industries (then Northern Aluminium) last year as secretary. His career with Aluminium Ltd., which began in 1949 with Aluminium Company of Canada, included an earlier period with Northern Aluminium, and he was latterly with Aluminium Secretariat, Montreal.

Mr. C. J. Buchanan-Dunlop has been appointed manager of the Birmingham area sales office in succession to Mr. D. W. Taylor who is to take over management of the London area sales office later this year.

* * *

The following retiring directors have been re-elected by **The International Nickel Company of Canada Ltd.:**

The Hon. Lewis W. Douglas, J. Roy Gordon, G. Arnold Hart, M.B.E., H. R. MacMillan, C.B.E., The Rt. Hon. Viscount Margesson, P.C., M.C., R. Samuel McLaughlin, H. C. F. Mockridge, Q.C., Theodore G. Montague, Sir Ronald L. Prain, O.B.E., George C. Sharp, John F. Thompson, The Rt. Hon. Viscount Weir, C.B.E.

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Following the recent retirement of Mr. J. S. Baillie, **Bruce Peebles and Co. Ltd.,** Edinburgh, have appointed Mr. J. Griffin, A.M.I.E.E., as publicity manager.

* * *

The **Cambridge Instrument Co. Ltd.** announce the appointment of Mr. K. J. Bush, A.M.I.E.E., as assistant sales manager, Mechanical Thermometer Division, Friern Park, N. Finchley.

The appointments are also announced of Mr. W. C. Orford, Mr. S. V. J. Crump and Mr. W. A. Hall as assistant resident engineers at the company's branch offices in Nottingham, Bristol and Manchester respectively.

* * *

Mr. R. H. Wilson is appointed a director of **CIBA (A.R.L.) Ltd.** Mr. Wilson, who joined the company in 1954, was initially associated with the development of "Araldite" epoxy resins and was appointed general sales manager last year.

Books for Your Library

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The leading article suggests various ways in which the supervisor can increase his influence to be predominating rather than dominating. As a beginning he can change his newspaper at times; look or listen to other broadcast programmes; be more venturous in his holidays. Be an informed citizen; attend a local council meeting or a police court in the gallery. Pop into that strange meeting advertised in the town; take up some form of public service.

Various aspects of accident prevention and factory fire dangers are also dealt with.

Eight steps to successful delegation is complementary to an article on how to train an understudy, since a good understudy is essential if the foreman is hoping for promotion himself.

In proportion to the total number of workmen in Britain, more foremen see a doctor each year than any other group of workers outside the mines.

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Desoutter Acquire New Factory

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It is intended that a new wholly owned subsidiary (with a nominal capital of £250,000) will be formed to operate this new acquisition as a separate unit of the Desoutter Group.

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BLACK AND DECKER ACQUIRES MAJORITY INTEREST IN FRENCH ELECTRIC TOOL FIRM

THE Black and Decker Manufacturing Co. of Towson, Maryland, U.S.A., has acquired a majority interest in the firm SOCOMEDA (Société de Constructions Mecaniques du Dauphine) of Lyon, France, a subsidiary of Landis-Gendron, S.A.

Since 1922, Socomeda has manufactured and marketed a diversified line of portable electric tools in the French and European markets. Electric tools for the "handyman" market and for heavy-duty industrial service; grinders, blowers and high-frequency electric tools are marketed under the "MICOX" brand. A line of specially-insulated electric tools is known as "MICOX-ISAL".

Socomeda's head offices are at 37 Rue Colin, Lyon. The electric tool factory is a 30,000 sq. ft. plant in the neighbouring town of Brezins. Here a complete manufacturing operation is performed, including the winding and assembly of motors. "Micox" sales, service and warehousing operations are maintained in Lyon and in Paris and "Micox" distributors are located throughout Europe and in many world markets.

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* * *

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* * *

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SIX EMI CONTROL SYSTEMS FOR SWITZERLAND

THE Société Genevoise D'Instruments De Physique, of Switzerland, has placed an order worth approximately £20,000 with EMI Electronics Ltd. for six EMI rotary control systems to fit "Rotoptic" rotary positioning tables. This order from Geneva follows exhaustive testing on two prototypes of the EMI equipment.

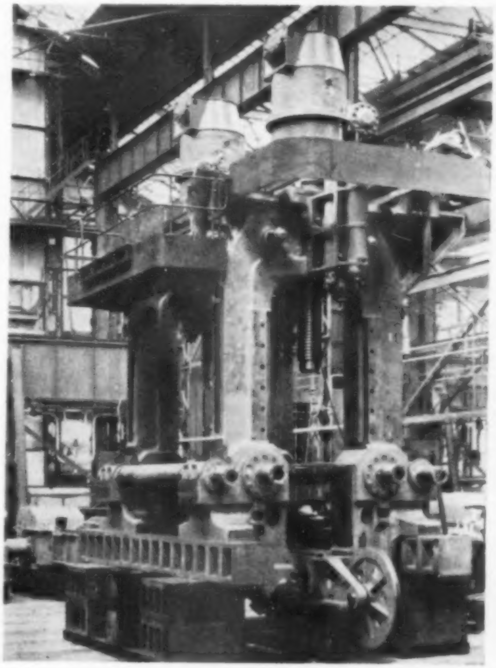
Similar EMI control systems have been supplied to well-known user companies in the United Kingdom, Belgium and Holland.

The accuracy of this equipment is said to be the highest available today in rotary control systems. It can be fitted with both 5- and 8-hole punched tape input and many special extra facilities.

This control equipment is another of the now familiar EMICON systems available for machine tools of all kinds.

SGIP sells this equipment in the United Kingdom through Société Genevoise Ltd, Newport Pagnell.

NEW MILL FOR SAMUEL FOX



A 42-in. × 108-in. blooming and intermediate mill under construction in the Bridgeton Works, Glasgow, of Davy and United Engineering Co. Ltd. (a member of the Davy - Ashmore Group). This mill will be installed at the Stocksbridge works of Samuel Fox and Co. Ltd. as part of the large-scale extension scheme. It will deal primarily with quality steels, producing a wide range of blooms and billets, and will be capable of rolling to a very flexible programme.

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The top of the strip, which is lightly corrugated for strength, is placed just below the level of the lawn, so that the mower blades can pass over it.

SIX EMI CONTROL SYSTEMS FOR SWITZERLAND

THE Société Genevoise D'Instruments De Physique, of Switzerland, has placed an order worth approximately £20,000 with EMI Electronics Ltd. for six EMI rotary control systems to fit "Rotoptic" rotary positioning tables. This order from Geneva follows exhaustive testing on two prototypes of the EMI equipment.

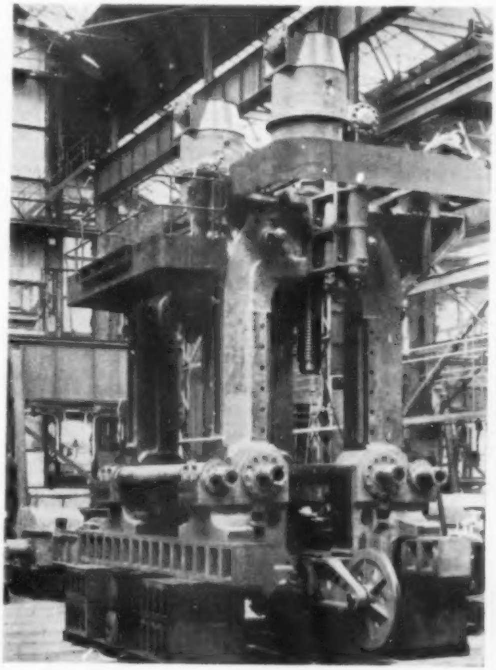
Similar EMI control systems have been supplied to well-known user companies in the United Kingdom, Belgium and Holland.

The accuracy of this equipment is said to be the highest available today in rotary control systems. It can be fitted with both 5- and 8-hole punched tape input and many special extra facilities.

This control equipment is another of the now familiar EMICON systems available for machine tools of all kinds.

SGIP sells this equipment in the United Kingdom through Société Genevoise Ltd, Newport Pagnell.

NEW MILL FOR SAMUEL FOX



A 42-in. × 108-in. blooming and intermediate mill under construction in the Bridgeton Works, Glasgow, of Davy and United Engineering Co. Ltd. (a member of the Davy - Ashmore Group). This mill will be installed at the Stocksbridge works of Samuel Fox and Co. Ltd. as part of the large-scale extension scheme. It will deal primarily with quality steels, producing a wide range of blooms and billets, and will be capable of rolling to a very flexible programme.

A PROBLEM OVERCOME

THE problem of installing lift-off furnaces in buildings with limited headroom can be overcome.

At the Wire Drawers (Midlands) Ltd., Victoria Wks, West Bromwich the furnace bases are placed in a well. Lifting is by a hoist from a beam supported by 'A' frames and there is enough clearance to move the furnace, inner covers and the spiders loaded with wire.

The plant, installed by Incandescent Heat Co. Ltd., is used for stress-relieving and annealing of coiled wire and narrow strip; outputs are up to 750 lb. per hour of steel wire at a temperature of 700° C. depending upon loading. (Courtesy of Wire Drawers (Midlands) Ltd. and Incandescent Heat Co. Ltd.)

RECONSTRUCTION OF THE LONDON METAL EXCHANGE

FOR the first time since the premises in Whittington Avenue were built for the London Metal Exchange in 1882 the building has undergone major alteration.

The great problem in redesigning the Exchange was to preserve as many traditional features as possible without producing undesirable contrasts between old and new.

The Ring, a circle of four long, curved benches where trading takes place, remains the same as it was when it was installed in 1882. The surrounding room has been completely modernized with a new illuminated ceiling and modern large windows.

The area incorporating the rooms of the Exchange has been adapted from a single- into a three-storey building. There is a new entrance hall and new reading and telephone rooms.

A clock-controlled system, incorporating a programme selector, control panel and electric bells replaces a manual bell to indicate the end of trading periods.

Among the many other innovations is an automatic lamp-signalling system to inform firms of telephone calls. Each member-firm has an illuminated number visible from the Ring.

GAUGE AND TOOL-MAKERS VISIT MOSCOW

A GROUP visit to Moscow by 48 senior executives of member-firms and the secretary of the Gauge and Tool Makers' Association took place in May.

In addition to paying an official visit to the British Trade Fair in the Solkiniki Park, the group visited a number of Russian factories in the Moscow area, each of which employed several thousand workers. These establishments included a machine-tool plant, a small tool, cutting tool, and tap and die plant, and a factory manufacturing gauges and measuring equipment, micrometers, etc. Visits were also paid to a small tool and machine tool research and development centre in Moscow, and to a Russian university for technical and practical engineering training.

The Association gave a reception at the Hotel Ukraine, Moscow, to two vice-directors of V/O "STANKOIMPORT", the Russian state organization for the import of foreign small tools, machine tools, hand tools, etc., and very satisfactory arrangements were concluded for promoting the sale of British precision tools and gauges to the U.S.S.R.

NEW LABORATORY FOR LAPORTE TITANIUM LIMITED

THE Technical Service Department of Laporte Titanium Ltd. have moved to new premises at 28 Milton Road, Harpenden, Herts.

The laboratory has been newly furnished and equipped and is set in sufficient grounds to provide a site for an additional exposure station for testing the company's products. The improved facilities for experimental investigations which are thus made available implement the company's policy of giving better technical service to the users of titanium oxide pigments. An invitation is extended to the technical staffs of titanium oxide users to visit the laboratories for discussions.

£½ MILLION ORDER FOR LOEWY

THE Loewy Engineering Co. Ltd. of Bournemouth has received orders from West Germany to the value of £½ million for three extrusion presses for the production of tubes and profiles; the presses will be supplied with "Loewy-Magnethermic" induction billet heaters.

STEEL COMPANY OF THOS. W. WARD GROUP ORDERS NEW ROLLING MILL

A NEW 14-inch merchant bar and section mill is to be installed at the Wolverhampton works of the Wolverhampton and Birchley Rolling Mills Ltd. (a member of the Thos. W. Ward Group of Companies). Work on the new project will commence in the near future, the total cost being more than half a million pounds. Orders for the new plant have been placed with The Brightside Foundry and Engineering Co. Ltd. of Sheffield, the rolling mill and its equipment costing more than £300,000. The structural steelwork department of the parent company—Thos. W. Ward Ltd.—will erect the buildings to accommodate the new mill and five new overhead electric cranes will be supplied and installed by John Smith (Keighley) Ltd., another member of the Ward Group.

The scheme will take about 2/2½ years to complete and will increase the productive capacity of the company to approximately 150,000 tons of steel bars and sections per annum.

NEW PLANT and EQUIPMENT

A monthly review of new machines, equipment, processes, etc., of interest to the producer and user of sheet metal

Automatic, Portable Coating-Drying Unit

AN automatic machine for applying and drying lubricating compounds on blanks prior to press shaping and drawing, is now being produced by Murray-Way Corporation. This new machine is claimed to cut production costs by eliminating the manual operations of "swab-sticking" or spraying of lubricants.

Mounted on a single, portable frame with foot-operated stabilizers, this economical machine consists of three components: an automatic loader, a roller-coater, and an infra-red, continuous-type oven.

A stack of blanks is manually placed on the loading platform where a vacuum cup picks up single blanks and deposits them one by one on the roller-coater lead-in conveyor. An air jet removes any extra blanks which might have stuck to the one being lifted. As a final precaution, a special sensing unit rejects any blanks which the air jet has failed to separate.

The lead-in conveyor carries the row of single blanks through the roller-coater, which may be quickly adjusted for gauge of stock and thickness of coating. From the roller-coater, a lead-out conveyor carries the coated blanks through an oven equipped with infra-red lamps.

These machines are easily manoeuverable from press to press, or may be stationed at a central supply location. The unit illustrated in Fig. 1 is designed for use with 10-in. to 20-in. blanks at a production speed of 400 pieces per hour. Units are available for use with both larger and smaller blanks at higher or lower production speeds. Production speed may be synchronized to match the stroke of the press with which the machine is being used.

British agents for this machine are Automation Ltd., Devonshire House, Vicarage Crescent, London, S.W.11.

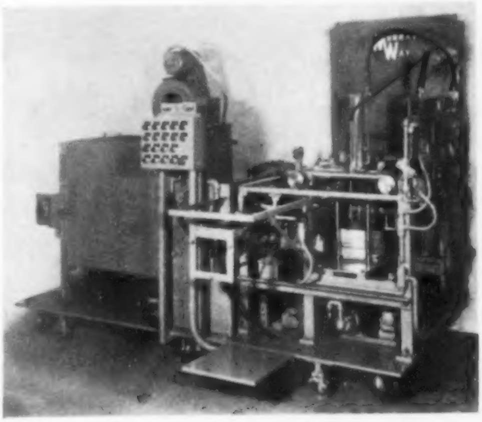


Fig. 1.—Coating-drying unit

Improved Welding Electrode

ELIMINATION of objectionable welding fumes, together with improved slag detachability are the main features claimed for the new Diadem "Ruby" range of electrodes recently introduced by Cooper and Turner Ltd., of Vulcan Road, Sheffield, 9.

This mild-steel electrode is designed primarily for fast, high-quality welds in the downhand position, although it is also suitable for vertical and overhead work. The Ruby range has full M.O.T., Lloyds and other official approvals. It complies with B.S. 639 : 1952, and B.S. 1856 regarding mild steel welding requirements and such other British Standards as B.S. 2642 covering the metal arc welding of medium tensile weldable structural steel to B.S. 968. Due to careful matching of the core wire and covering, it is particularly suited to the production of smooth dense welds of high strength, ductility and toughness by welders of only limited experience.

The "Ruby" range is designated E.217 on the B.S. 1719 coding and E.6012 on the AWS-A.S.T.M. scale. The mechanical properties include a yield point of 24 to 28 tons per sq. in., an ultimate tensile strength of 29 to 34 tons per sq. in., and an Izod impact value of 50 to 70 ft. lb. The chemical analysis is carbon 0.008 to 0.10 per cent, silicon 0.11 to 0.14 per cent, manganese 0.55 to 0.65 per cent, sulphur 0.025 to 0.035 per cent, phosphorous 0.015 to 0.025 per cent. The electrodes are produced in a range of ten sizes, from 16 gauge to $\frac{3}{8}$ in., and are supplied in 14 lb. or 7 lb. standard packs, according to size. The deposition time per foot of electrode at maximum current is 55 seconds for an 8 gauge electrode and 68 seconds for a 4 gauge electrode. Current values are 170 amps average and 190 amps maximum at 8 gauge and 290 amps average and 315 amps maximum at 4 gauge.

New Methods of Fixing Honeycomb

A NEW method of fixing Hexmetal, a honeycomb structure made of strip metal in monolithic refractory linings has resulted in considerable saving in time and labour. The method is being used with success in many refractory linings.

Previously, headed studs were affixed to suitable centres on the plates for securing the reinforcement and to take the weight of the lining. The thickness of the lining determined the length of the studs used. After the first layer of refractory was applied to the level of the studs, Hexmetal was welded to the studs. A final coat of refractory was then applied to fill the cells of the Hexmetal.

With the new method, a preformed mesh of Hexmetal is supplied with lugs of the appropriate length secured in place. The whole assembly can then be anchored to the shell to be lined in one welding operation. Gunning is then carried out in one operation by firing through the mesh; the cost of installing the complete lining is thus reduced considerably.

Hexmetal surface armour is being used increasingly for blast furnaces, cyclones, dust collectors, sinter plants and coke bunkers, etc. The product is made by Causeway Reinforcement Ltd., of Five Ash Works, Northfleet, Kent.

Power Presses

THE new range of Bentley friction clutch power presses, manufactured by Samuel Griffiths (Willenhall) Ltd., comprises three non-inclinable presses of 60, 100 and 200 tons respectively. The 6-h.p., 60-ton press gives 50 strokes per min., has a fixed stroke up to 6 in. max., and 18 in. daylight on top dead centre with 3 in. ram adjustment up. Its table surface is 20 in. wide × 24 in. with 12½ in. dia. bed aperture. The 10-h.p., 100-ton press (Fig. 2) gives 40 strokes per min., has fixed stroke up to 8 in. max., and 22 in. daylight on top dead centre with 4 in. ram adjustment up. Its table surface is 26 in. wide × 32 in. with 15½ in. dia. bed aperture.

The frame is fabricated from steel plates and so designed that no weld is in tension or shear. Ram and con. rod are of cast steel, and the shafts of nickel-chrome steel. The four lengthy guideways, being at the corners of the ram, allow intricate tools and dies to be accommodated.

Control of ram movement is effected by a multi plate adjustment air clutch and brake, a 12-in. clutch controlling the 60-ton, and a 16-in. clutch the 100-ton machine. Control may be either hand- or foot-operated, a selector switch giving alternative control of clutch only (with isolated motor) and inch, for toolsetting; or operation by single, repeat, or continuous strokes.

Standard equipment includes top extractor; ratchet adjustment to ball screw; pneumatic equipment including oil mist lubricator; and lubrication system.

Silicone Rubber

I.C.I. Nobel Division has added a further two products to its range of "Silcoset" silicone rubbers. These rubbers, which cure at room temperature, were first introduced in 1960.

"Silcoset" 103 is a white solvent-free paste that cures at room temperature to a resilient silicone rubber after addition of the appropriate curing agent. This rubber, similar in properties to the pink "Silcoset" 100, introduced in 1960, is recommended for high temperature sealing, patching, caulking, potting and the encapsulation of sensitive electronic assemblies. Dissolved in a solvent it can be sprayed, and cloth may be coated by spraying or dipping.

"Silcoset" 104 is thixotropic, with flow properties that make application from a caulking gun eminently satisfactory. "Silcoset" 104, which can be readily bonded to primed metal surfaces, is especially suited for sealing, patching and caulking when a room temperature cure is necessary.

Four curing agents are available for these rubbers. "Silcoset" Curing Agent "A" is a general-purpose curing agent, "B" is comparatively slow acting and useful when long pot life is needed, "C" is a non-toxic agent, and "D" is very fast acting.

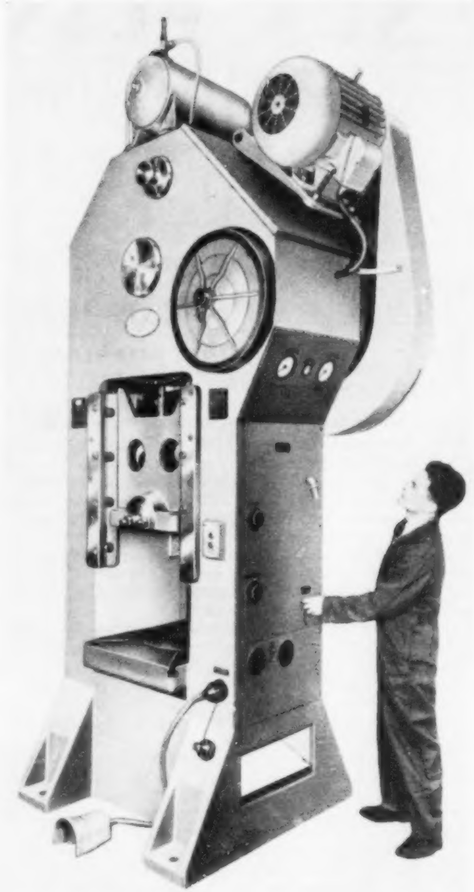


Fig. 2.—100-ton power press

Electrode for Mild Steel

ASSOCIATED ELECTRICAL INDUSTRIES LTD. have introduced a new Class E.217 mild-steel welding electrode, the "Gazelle." This electrode represents an addition to the range formerly known as Metrovick electrodes (with names Sylvick, Castivick, etc.).

The "Gazelle" has been developed to obtain smooth and speedy welding; features are high travel speeds, longer runs per electrode than with standard Class 2 electrodes, and a combination of characteristics that ensure high quality welds with maximum ease of operation.

Of the non iron-powder, contact type, the "Gazelle" is said to be capable of satisfactory operation over very wide current ranges; for example, the current range for a 4-gauge is 190/350 amp.

Operation is similar to that of iron-powder contact-type electrodes, with an added advantage of negligible splatter, and deslagging properties are high.

"Gazelle" electrodes are approved by Lloyds and the Ministry of Transport, and are now available for test purposes or for normal demands.

(Continued in page 552)

Fig. 3 (left).—Drum opener

Fig. 4 (right).—Resistance welding machine

Drum Opener

A NEW product, designed and manufactured by Moon Brothers Ltd. of Beaufort Road, Birkenhead, was introduced recently. The machine, Model C.D. (Fig. 3), is designed to cut the top off steel drums of almost any size. It is entirely hand-operated, supplied with suitable gauging rollers to hold it in position on the drum, and is operates by cutting through the body of the drum just below the end seam. Operation by the handle through reduction gearing is extremely easy. Hardened tool steel is used for the actual cutters to secure maximum working life and all components are made to machine tool standard. This also ensures that the top edge of the drum body is cut square and clean to render it suitable for possible reconditioning.

The machine is envisaged for a variety of applications in the oil, chemical and paint industry, etc., or to any other user who requires the rapid removal of a quantity of drum heads to gain full diameter access to the interior of the drums.

Another application is in drum re-conditioning plants when it is sometimes required to remove old end stampings and then re-flange for double-seaming new stampings, or to externally curl the top edge of the body for the fully open top type of drum. The clean edge left by the drum opener readily permits either flanging or curling to be carried out.

Resistance Welders

STANDARD RESISTANCE WELDERS LTD., Maypole Fields, Cradley, Staffs, have developed a low-capacity vertical sliding head, air-operated combined spot, projection and stitch welder (Fig. 4).

As many as 250 progressive spots per minute are obtainable on light-gauge material, but the rate of welding varies with the thickness of the material being welded.

Three sizes of this design are available at nominal ratings of 25, 35 and 50 kVA, at 50 per cent duty cycle.

Each welder is designed to give the requisite maximum electrode tip pressure when working on an air line pressure of 80 lb. per sq. in. For pressure regulation a control valve is located between the air filter and lubricator. The electrode arms can be moved through the horizontal plane. The bottom arm is bored at both ends to take an electrode, the bore at one end holding the electrode vertically, while the other end is set at an angle of 20 deg. Heat regulation is by means of a 6-stage off-load rotary switch.

The transformer is of the S.R.W. high-efficiency low-impedance type, designed to operate on two phases of a 400/440-volt, 50-cycle, 3-phase electric supply. Glass braided and silicon bonded wire is used for primary winding, thus giving a high safety factor to the transformer.

A 4-stage electronic timer working in conjunction with the ignitron contactor or contactor switch, to control the welding cycle is provided—squeeze, weld, forge and off. Single or repeat operation is catered for.

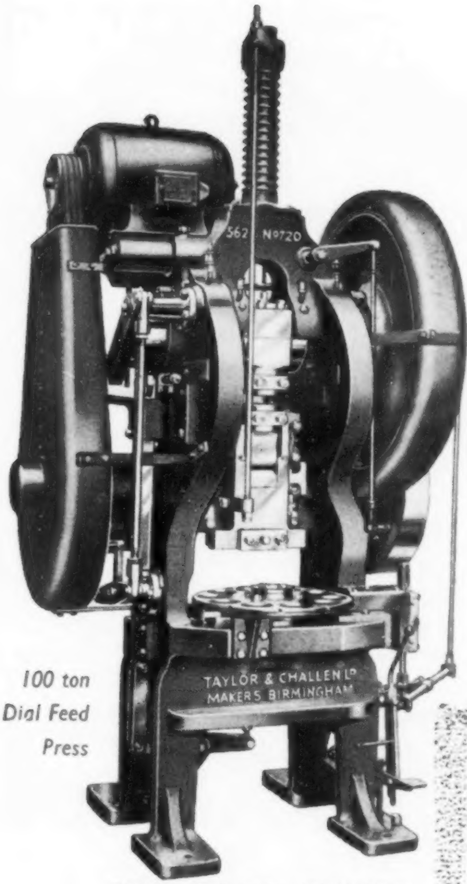
		Range in Cycles:
Squeeze	..	3–20, 15–100 (two ranges)
Weld	..	3–20, 15–100 (two ranges)
Forge	..	3–50
Off ..	..	3–50.

Electric Power Conversion

INVERTER units for use in almost any situation where it is desired to operate, from direct current, electrical equipment normally requiring an alternating current mains supply, are now being produced by the Electronic Apparatus Division of Associated Electrical Industries Ltd.

These d.c./a.c. units are being made in three ratings, but a wider range is being developed. The first of the three units rated as at present was designed for the British Transport Commission to operate from 110 volts d.c. giving 230 volts a.c. at 1,200 c/s and 240 watts, and was for the fluorescent lighting of railway coaches. The second is a low-priced unit of interest to farmers. It operates from any smooth 24-volt d.c. supply (such as tractor batteries) giving an output of 230 volts a.c., 8 kc/s, 40 watts, and can be used for operating small fluorescent lighting installations.

Originally developed for I.C.I. Ltd. for use as a power pack supply for shunting loco communication equipment, the third unit also operates from a 24-volt d.c. supply. The output is 230 volts, 50 c/s at 100 watts, the unit thus being suitable for a wider range of applications demanding larger power supply.



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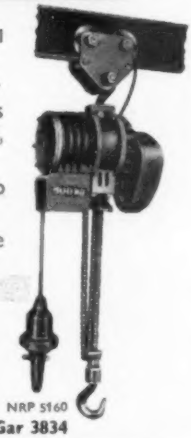

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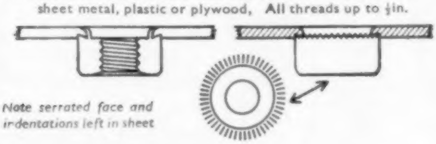

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No. 265.	6 ft. × 18 g.—	6" throat—	25 tons
No. 56A.	6 ft. × 16 g.—	6" throat—	25 tons
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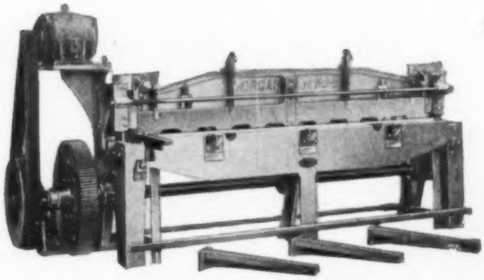

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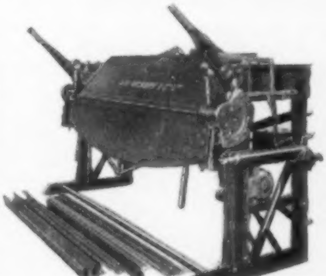

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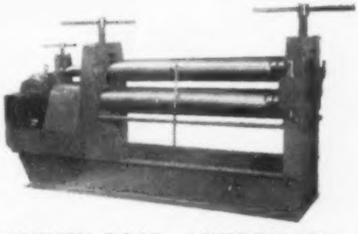

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BLISS Fully Automatic Soldering Machine for sale. For side seams, top and bottom seams, on 4-gallon Imperial cans, 9¼ in. square x 13¾ in. deep. Automatic top and bottom seams soldering unit with double deck with fluxing, preheating roller, soldering, wiping and cooling stations. Arranged motor drive 440 volts 3 phase, 50 cycles. Photographs and full description from F. J. Edwards, Ltd., 359, Euston Road, London, N.W.1, EUSton 5000; or 41, Water Street, Birmingham 3, CENtral 7606.

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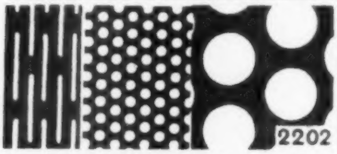

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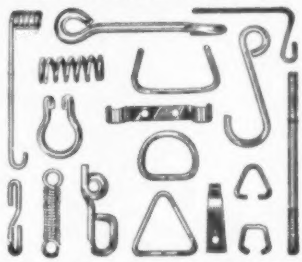

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